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Building a Digital Gateway: A Case Study in Enhancing Access to the BLM Aerial Photography Resources



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Applications of Science # 7360
Enhanced Use of the BLM Aerial Photographic Archive
Final Report



National Science &
Technology Center



Bureau of Land Management

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BLM Library
Denver Federal Center
Bldg. 85, OC-521
P.O. Box 25047
Denver, CO 80225

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Building a Digital Gateway:

A Case Study in Enhancing Access to the BLM Aerial Photography Resources

Executive Summary

Funding for this study was provided through the FY 2003 Applications of Science Initiative for the purpose of improving access to BLM's natural resource information.

For more than 30 years, the Bureau of Land Management has maintained an archive of original aerial photography coverage on the Denver Federal Center. This archive contains approximately 500,000 frames, contained on more than 3000 rolls of large format aerial photography film.

Each year the archive grows as new photography is acquired. The BLM began acquiring aerial photography on a regular basis in Oregon in the 1950s, with the rest of the western states following in the 1960s. In the early 1970s what is now the Bureau of Land Management National Science and Technology Center became a central repository and archive for the original roll film.

Aerial photography is an essential tool for accurate analysis and monitoring of public land resources. It is used to analyze long-term vegetative trends, document mineral development activities, evaluate hydrologic conditions, monitor land use changes and scientifically analyze changes in landscape environments.

The NSTC Aerial Photography Archive Pilot Intranet Website provides the beginnings of a digital gateway to access both spatial and archival information by searching through thousands of photo center records. Aerial photography contained in the archive has limitless value to resource managers because it can help determine land use, degree of habitat fragmentation, and baseline of resource conditions. This information is invaluable for a range of land management issues including determining habitat condition and conducting regional assessments.

As a result of this effort the on-line database contains 22,790 individual photo centers that are mapped and searched through the mapping interface, a part of the Pilot Intranet Website. The user can search for, locate, and/or create a report of available photo centers based on attributes of the photo center such as year, id, film type, project boundary, latitude/longitude, film scale and roll number. For 190 of the 22,790 photo centers, the user can link to a scanned thumbnail images of the actual image that is stored in the BLM Archive.

Thanks to the responses to the Pilot Intranet Website Questionnaire, the basic functionality needed to gather locational and other archival information on the holdings of the NSTC Aerial Photography Archive is in place, providing the Bureau with access to this important resource.

A fundamental goal of this project was to enhance the use of the aerial photography housed in the NSTC Aerial Photography Archive by providing scanned, digital imagery to the field for use in answering scientific and resource questions. Based on the results of the questionnaire, the historical DOQQs are not only of great value to the project for which they were being used, but will also be of value for answering a large variety of land management questions.

Original Proposal

Funding for this study was provided through the FY 2003 Applications of Science Initiative for the purpose of improving access to BLM's natural resource information.

Original Proposal -- Enhanced Use of the BLM Aerial Photographic Archive

NSTC proposes to scan some of the 450,00 aerial archive frames, move this digitized data into a GIS tool and provide the data and tool sets to several of the appropriate science investigations to determine how effective the data and tool set are in scientific investigations. Aerial photography is an essential tool for accurate analysis and monitoring of public land resources. It is used to analyze long-term vegetative trends, document mineral development activities, evaluate hydrologic conditions, monitor land use changes and scientifically analyze changes in landscape environments. The photography housed in the archive is heavily utilized within the agency and also by non-Bureau personnel, including the public.

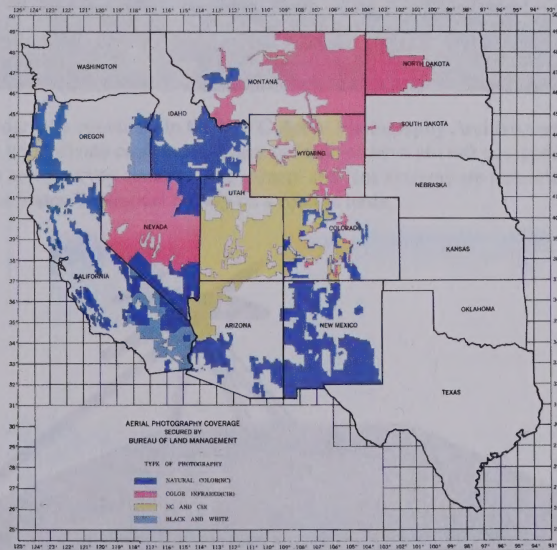
Present GIS tools available to all BLM personnel can utilize digital imagery directly in support of bureau-wide workload priorities. Prioritization strategies that would govern how photography would be selected for scanning and the associated retrieval database would be designed and several initial aerial projects would be selected and scanned as part of this proposal. For this proposal, the selection of projects to be scanned would be targeted to maximize the support to approved science initiatives. State BLM specialists would work in partnership with the NSTC staff to develop the overall photography selection strategy. Commercial entities would be utilized to scan the photography. Deliverables would include: (1) states and NSTC would develop the prioritization strategy for the selection of aerial projects for scanning; (2) NSTC will design the retrieval database requirements; and (3) several top priority projects (supporting approved science initiatives) would be scanned by a commercial firm to test and refine the scanning specifications and retrieval database. These deliverables would ensure that our state-level BLM partners are fully involved in the critical front-end decisions.

BLM NSTC Aerial Photography Archive - A Historical Perspective

For more than 30 years, the Bureau of Land Management has maintained an archive of original aerial photography coverage on the Denver Federal Center. This archive contains approximately 500,000 frames, contained on more than 3000 rolls of large format aerial photography film.

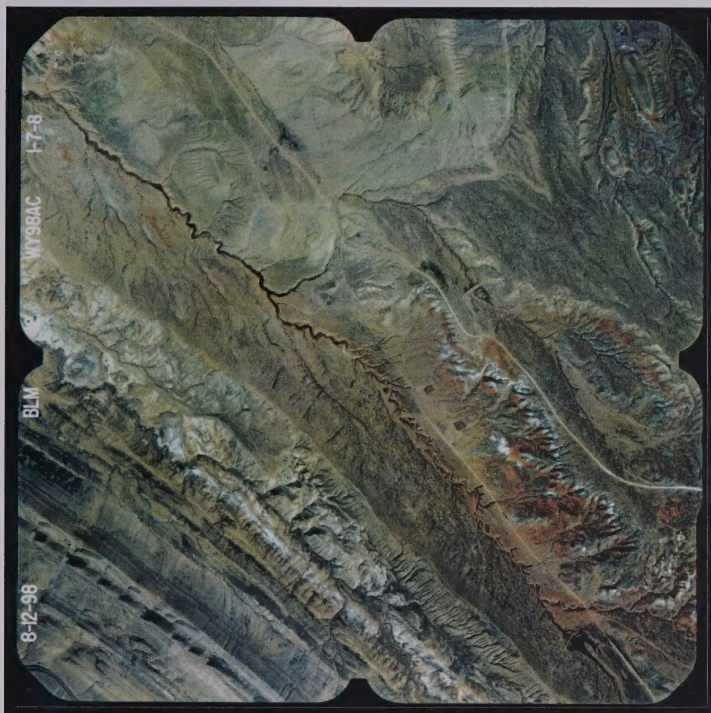


Each year the archive grows as new photography is acquired. The BLM began acquiring aerial photography on a regular basis in Oregon in the 1950s, with the rest of the western states following in the 1960s. In the early 1970s what is now the Bureau of Land Management National Science and Technology Center became a central repository and archive for the original roll film. Photography contained within the NSTC Aerial Photography Archive covers portions of lands administered in the 12 contiguous western states. A separate archive is maintained at the BLM Alaska State Office which houses the aerial photography acquired for that state.

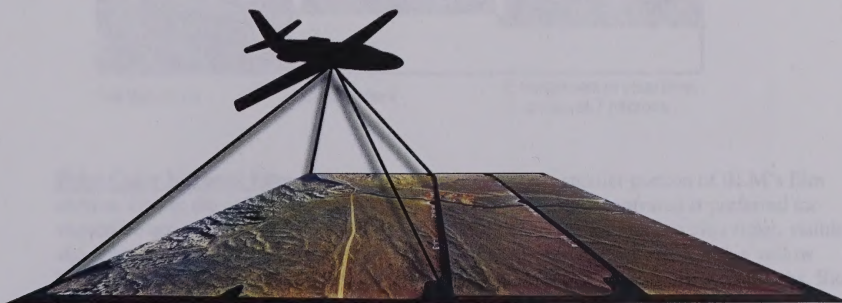


Large-format Aerial Photography

The NSTC Aerial Photography Archive contains large-format photography, each frame is approximately 9 x 9 inches. A system of calibrated fiducials is imprinted on each image, as well as information pertaining to acquisition time, altitude, and lens used. The image below is 50 percent of actual size.



The photography contained in the NSTC Aerial Photography Archive was acquired through contracts with private companies. These companies have aircraft equipped with high-precision aerial survey cameras. The camera and lens systems are inspected and calibrated by the United States Geological Survey on a routine basis.



Film Types

Over the life of the archive, three types of aerial photography have been acquired based on cost, resolution, and analysis needs. These film types are black and white (B&W), natural color, and false color infrared.

B&W Negative Film: Prior to 1970, all of the BLM's aerial photography projects were flown with B&W negative aerial film. This general purpose coverage yields B&W paper print or film products suitable for a wide variety of uses relating to surface mapping and/or interpretation. With the absence of color, certain limitations for utilization can be expected. However, the historical data contained within the B&W film portion of the archive is proving to be invaluable for change detection studies conducted in a variety of disciplines.

Medford, Oregon Black and White Examples
Approximate Photo Scale 1:12000 - Flown on 7/8/1959



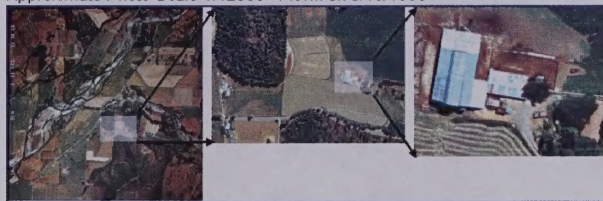
Full 9x9 photo

Enlargement

Enlargement to pixel level
Scanned at 7 microns

Natural Color Negative Film: The largest portion of BLM's aerial photography coverage exists as natural color negative film. This original film, once exposed and developed, is in "complimentary" negative form. When reproduced through conventional means as either a paper or film product, the resultant reversed or "positive" image appears just as the human eye would perceive it, as a natural color scene. Photo interpretation applications for this daylight exposure film are almost endless.

Medford, Oregon Natural Color Examples
Approximate Photo Scale 1:12000 - Flown on 6/18/1980



Full 9x9 photo

Enlargement

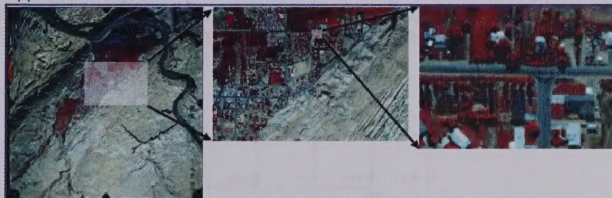
Enlargement to pixel level
Scanned at 7 microns

False Color Infrared Film: These films comprise a much smaller portion of BLM's film archive. Due to the unique characteristics of this film, false color infrared is preferred for vegetative and hydrologic studies. False color infrared film is sensitive to ultraviolet, visible and infrared radiation to approximately 900 nm. When the film is exposed with a yellow filter, the emulsion layers become sensitive to only green, red and infrared wavelengths. Blue radiation is absorbed by the filter; hence, the greater haze penetration ability of infrared film.

The most obvious characteristic of false color infrared films is the distinctive pink to magenta coloring of most live and healthy vegetation (exclusive of many conifer species). Almost all surface features distinguishable with B&W or natural color film can also be distinguished with false color infrared reproductions (assuming said features are NOT reliant on "natural" color differentiation as would be the case with some geologic profiling.) This photography does not capture ambient temperature variation as is the case with thermal imaging.

Moab, Utah Infrared Examples

Approximate Photo Scale 1:31680 - Flown on 6/30/1975



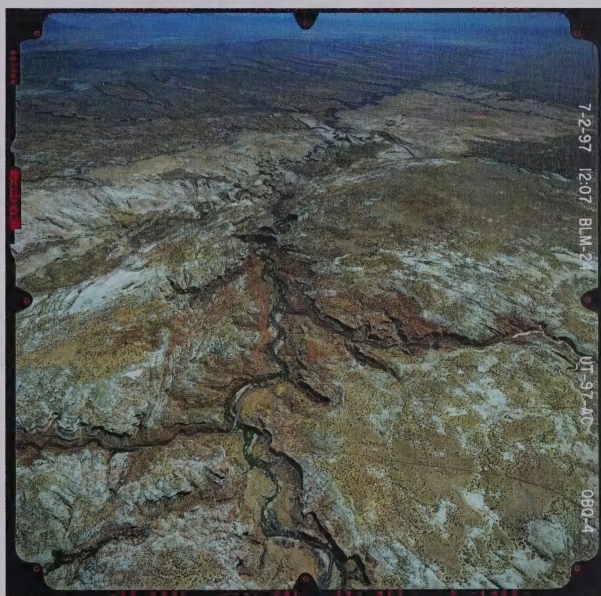
Full 9x9 photo

Enlargement

Enlargement to pixel level
Scanned at 7 microns

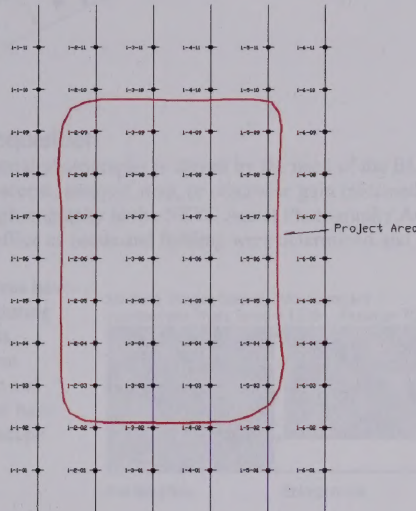
Aerial Photography Projects

The photography contained within the archive was acquired at the request of a particular BLM state or field office. The requesting office defines the scale, area of coverage, and film type. An aerial photography project is then created. The majority of these aerial photography projects are taken from a vertical perspective providing a "map-like" photograph of the earth's surface. Over the years some special missions have been flown for the purpose of taking oblique photographs. Oblique photographs are taken when the camera is set at a non-perpendicular angle to the ground and can produce dramatic results.

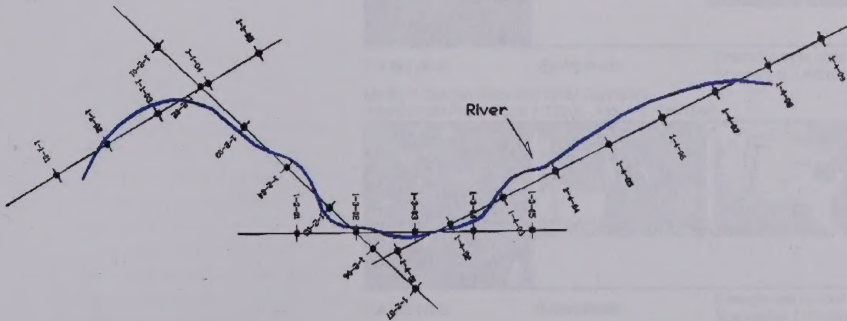


Traditionally three planning approaches have been taken to ensure photographic coverage of the project area; resource, riparian, and special purpose.

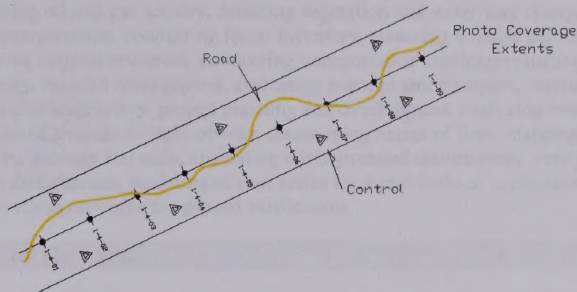
Resource Projects: Resource scale photography systematically covers large blocks of land that often trend north-south or east-west. The path the aircraft takes, or flightlines, are planned to ensure that there is adequate side lap so gaps in coverage do not occur. A center point for each photograph is also delineated and positioned so that there is a 60 percent overlap with the adjacent photograph along the line of flight, providing stereoscopic coverage. A scale 1:24,000 (1 inch = 2000 feet) is typical for resource scale photography projects.



Riparian Projects: Riparian photography is taken in such a manner as to maximize the coverage along the course of a water way. The direction of the water way determines the orientation of the flightlines. The scales vary, although photography is normally 1:12,000 or larger, and flown in such a manner as to follow the river corridor.



Special Projects: Special purpose aerial photography is usually flown at very large scales (1:3000 to 1:12,000) in support of the photogrammetric compilation of topographic base maps.



Frequency of Acquisition

The acquisition of aerial photography is driven by the need of the BLM to document, inventory, monitor, access, analyze, map, or otherwise gain information about the land it manages. Thus, the photography in the NSTC Aerial Photography Archive was acquired by BLM state or field office as needs and funding were determined and made available.

Many geographic areas have been photographed during multiple time periods, providing an excellent opportunity to detect and quantify changes that have occurred to the landscape.

Medford, Oregon Natural Color Examples
Approximate Photo Scale 1:12000 - Flown on 7/22/2001

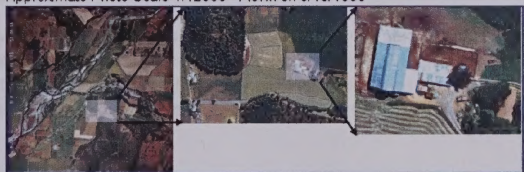


Full 9x9 photo

Enlargement

Enlargement to pixel level
Scanned at 10 microns

Medford, Oregon Natural Color Examples
Approximate Photo Scale 1:12000 - Flown on 6/18/1980



Full 9x9 photo

Enlargement

Enlargement to pixel level
Scanned at 7 microns

Medford, Oregon Black and White Examples
Approximate Photo Scale 1:12000 - Flown on 7/8/1959



Full 9x9 photo

Enlargement

Enlargement to pixel level
Scanned at 7 microns

Use of Aerial Photography

As mentioned above, the applications for the use of aerial photography are virtually endless. As we move more into a digital world, the uses of the images stored in the archive will continue to grow. Current uses of archival photography include, but are not limited to: monitoring oil and gas activity, detecting vegetation and water way change, stereoscopic photo interpretation, conducting forest inventory, assessing wildlife habitat, locating and evaluating cultural resources, conducting transportation studies, evaluating watershed hydrology, riparian management, evaluating contaminant transport, conducting flood studies, hazmat characterization, project planning and development, analyzing trends, evaluating questions of trespass or right-of-way, determining extent of fires, mapping natural resources - including geology and soils, evaluating mining-related disturbances, verifying past and present disturbances, modeling of time series for a multitude of applications, and identifying transportation networks for ground verification.

Archival Records

BLM Aerial Photography Information Catalogue

As the BLM began to acquire multiple projects, reference materials for each state were developed on 1:1,000,000 scale statewide base maps. These maps show the project boundary coverage and other information. In 1979 statewide level base maps were reduced and combined into the Summary of BLM Aerial Photography Information Catalogue. This catalogue contains maps for each western state (except Alaska) depicting the project coverage and lists associated project information. Updates to the catalogue have occurred on an as needed basis.

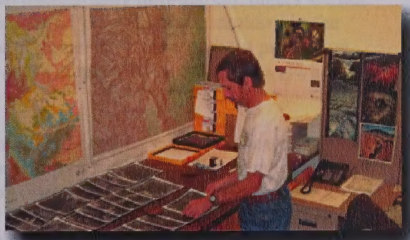
Copies of this catalogue have been distributed to a variety of contacts in BLM state and field offices. Various other users of aerial photography such as other federal agencies (USGS, USFS, NPS, etc.), state and local governments, private individuals and companies have also requested and received the Summary of BLM Aerial Photography Information Catalogue. A mailing list has been maintained for the distribution of updates to the catalogue. Some contacts have only received the selected state(s) that they need, while others receive the entire catalogue (Western US).

The Aerial Photography Information Catalogue is maintained in a paper format, and the information contained has provided vital aerial photographic project information to BLM personnel, as well as personnel from other government agencies and the public for over 30 years.

Flight line Index Maps

As part of the aerial photography contracting process flight line maps are created for each aerial photography project. These maps relate vital information to the contractor and include the desired scale, type, location, and orientation of photography to be flown. These maps are developed from the requestors specifications by the NSTC or the state office Contracting Officers Representative (COR).

Index maps utilize standard USGS Quadrangle maps of scales 1:250,000 to 1:24,000 scales, with 1:100,000 being the most common for resources scale photography. After aerial film is flown, the contractor identifies the actual location of the center of each frame of aerial photography as a spot on the USGS base map. The spot flight line indexes are part of the deliverables for the contract. The COR reviews these maps as part of the contract inspection process.



Virtually all aerial photography film contained within the NSTC Aerial Photography Archive has an accompanying flightline index map. The majority of aerial photography projects have the more familiar spot flightline index map, while a few older projects have the photomosaic type indexes. Mylar copies of the flightline index map are provided to the office who requested the photography.

Access to records

Master copies of the Summary of BLM Aerial Photography Information Catalogue and the Mylar flightline index maps for each aerial photography project are maintained as part of the NSTC Aerial Photography Archive. In the past these documents were produced manually and maintained in a hardcopy format. As this process began well before the use of Geographic Information System (GIS) was commonly used within the Bureau, updates were labor intensive. The many hours spent creating and maintaining these documents were vital for providing a gateway to accessing the photographic images contained on over 3000 rolls of original aerial film.

Copies of these documents are routinely provided to BLM field offices either as part of the contracting process or as requested, traditionally to a single person within each state. Some states are proactive with regard to distributing aerial photography information, others are not. Often one office or one person will hold the information of photography completed in the state/resource area. Thus, problems may occur should that person leave without passing on information, or when the catalogue or index maps are in another office and copies are hard to get when needed.

The majority of BLM states maintain these records in hard copy format. Some states, such as New Mexico and Oregon, have a statewide approach for converting the flightline index maps into a digital format and provide digital information over the web.

However, a Bureau-wide approach to collecting information about the holdings within the NSTC Aerial Photography Archive and making that information available to the greater BLM users community has not yet occurred.

Archivist at the NSTC provide support within BLM, to other government agencies, and to the public by researching, locating, and arranging for reproduction of aerial photography housed at NSTC.



Analysis of BLM Requirements

Customer Input

A key component to the completion of this project was canvassing the personnel within the BLM in order to develop a prioritization strategy for the selection of aerial photography to be scanned. Prohibitions imposed under a continuing resolution at the beginning of FY 2003 precluded a formal meeting of potential BLM "customers." A more informal approach to gathering information via e-mail and telephone conversations was conducted to determine candidate aerial photography projects for scanning.

This canvassing process began with investigating the need for digital imagery by other science projects. This led to the question "does the NSTC Aerial Photography Archive contain photography that covers the area of emphasis of my project?" In order to answer this question it was necessary to turn to the hardcopy records. As a result it was determined that, while there is a definite need for digital imagery, a greater bureau-wide need is to have digital, spatial access to the aerial photography holdings of the aerial photography archive.

Project Goals

Based on these discussions, the original proposal was expanded to include the following goals:

- Develop a pilot intranet website that provides aerial photography locations and other archival information (digital version of flightline index map), accessible in a GIS format, for selected aerial photography projects.
- Provide selected scanned, georeferenced digital imagery from the NSTC aerial photography archive to the field offices for use in support of land management issues, and receive feed back from the field offices.
- Produce a final report that includes user feed back on the utility of scanned imagery in making scientifically based land management decisions and the ease of access to information via the pilot intranet site.

Development of a Pilot Intranet Website

Objective

To improve access to and increase utilization of NSTC's Aerial Photography Archive, a GIS interface is being developed that will, when fully implemented, provide online-interactive access to BLM aerial photography project data.

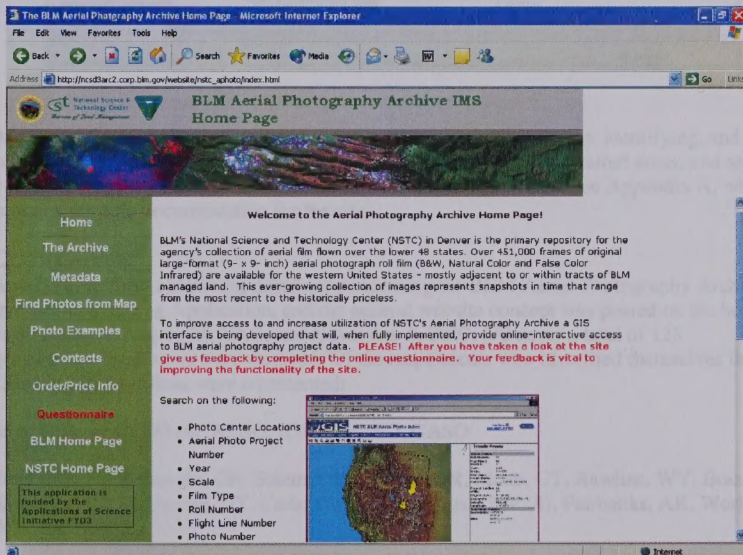
The site is currently located at the following url:

http://ncsd3arc1.corp.blm.gov/website/nstc_aphotos

Basic Functionality

Home Page

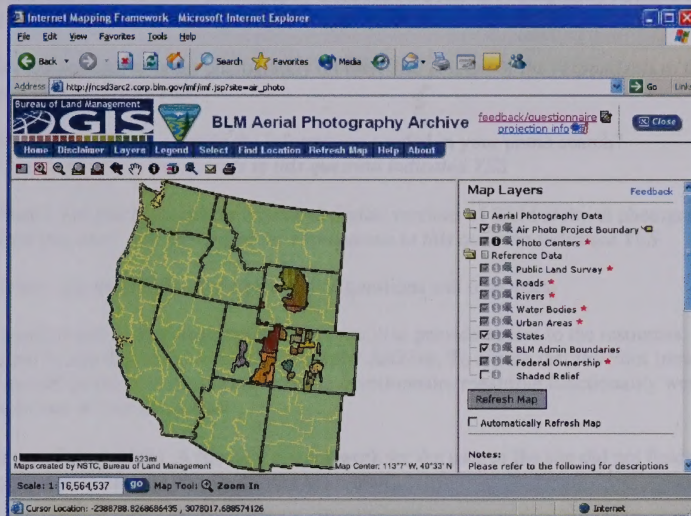
The BLM Aerial Photography Archive Home Page is the starting point for accessing the aerial photography archive pilot application. Contained here is information concerning the BLM Aerial Photography Archive, and an explanation of the mapping application being developed to complement the archive. Also displayed are comments concerning the progression of site development, other partners who are involved in development of the application, and a request to users to submit their comments on the sites functionality via the online questionnaire.



Interactive Mapping Application

The BLM Aerial Photography Archive Internet Mapping Service (IMS) is the interactive mapping application designed for exploring the large NSTC Aerial Photography Archive. This web application uses several modern Geographic Information Systems and internet server software packages to provide the user with the ability to use maps to query available photography by physical location.

In addition, the user can also perform queries based on latitude/longitude or UTM coordinates, BLM field office boundaries, photography date, type of photography (B&W, color, CIR), or BLM Project Number.



Additional functionality includes but is not limited to: creating reports, identifying, and zooming in and out on different areas of the map, printing maps of desired areas, and sending e-mail message with attachments containing the map image. Please see Appendix A, which contains the help documentation for the site.

Questionnaire

A web-based form containing questions concerning the BLM Aerial Photography Archive, Interactive Mapping Application, and the general website concept was posted on the home page. Between August 28, 2003, and November 5, 2003, (70 days) a total of 128 questionnaire responses were received. Of the respondents who identified themselves the following BLM offices were represented:

State Offices: ORSO (4), AZSO, IDSO, WYSO, CASO

Field Offices: Prineville, OR, Salem, OR, Eugene, OR, Moab, UT, Rawlins, WY, Boise, ID, Shoshone, ID, St. George, UT, Cedar City, UT, Tonopah, NV (4), Fairbanks, AK, Worland, WY, and NSTC

Results Overview

The responses to the online questionnaire provided valuable insight into the BLM community, both with respect to the use and knowledge of aerial photography and the concept and usability of the pilot intranet website. Many favorable responses were received such as: "I haven't ordered aerial photography from NSTC because I have no idea what is available. Once we know what is available I suspect you will have a very great deal of use, particularly if it's 'easily' downloadable. The uses for this type of aerial photography are almost limitless. One of the most valuable applications would be for change detection work."

Although not everyone who completed the questionnaire responded to each question, the responses to the following questions were particularly informative.

- Have you ordered aerial photography from NSTC's Aerial Photography Archive in the past? *60 percent of the respondents to this question indicated YES*
- Would you like to order photography on line? *100 percent of the respondents to this question indicated YES*
- Would this website provide the information needed in your photo search? *99 percent of the respondents to this question indicated YES*
- Would you like to be able to download digital versions of BLM archival photography from this site? *100 percent of the respondents to this question indicated YES*

Please see Appendix B for a complete list of questions and responses.

An important part of this Application of Science is to provide access to the resources contained within the NSTC Aerial Photography Archive. To ensure that the Pilot Intranet Website will do this, the comments from the questionnaire regarding functionality were placed in one of four categories:

- **Immediate Action:** A function did not work for the user or the site did not function (this type of problem was communicated via e-mail).
- **Functionality Enhancements - Short Term:** Both content and cosmetic changes that improve the site usability and can be made easily without the acquisition of additional data layers.
- **Functionality Enhancements - Long Term:** Suggestions for improvement which require extensive programming updates and/or the acquisition of additional data layers.
- **Out of Scope:** Suggestions for addition of data or functionality that is beyond the original scope of the application.

Status

As of December 12, 2003 the following steps have been completed in the building of the Pilot Intranet Website:

- Conceptual Application
- Database Design (Please see Appendix C)
- Data Development and Implementation (Please see Appendix D)
- Hardware/Software Configuration (Please see Appendix E)
- Application Design (Please see Appendix F)
- Cartographic Design (Please see Appendix G)
- Website Customization
- Final Database Design Adjusting to Photo Data from Contractors

- Aerial Archive IMS Home Page Design
- Review/Comment Process Design

Outstanding Items

At the time of the completion of this report the following items await completion:

- Finalization of FGDC Compliant Metadata for the Aerial Photography Project Boundaries.
- The loading of digital statewide photo center data for Colorado, New Mexico, Utah, and Wyoming, which will occur pending completion of the QC process.
- The conversion from hardcopy flightline index maps to digital statewide photo center data for Arizona, California, Montana, Nevada, and Idaho are currently scheduled for completion by the contractor. This data will be loaded after delivery and inspection.

Development of Digital Orthophotographs

Objective

Based on the feedback received during the informal requirements gathering portion of the project it was determined that georeferenced imagery would be of more value to the BLM field office user than a simple scan of the archival film. The applications for which the imagery would be used involved the evaluation of change over time. This change could be most thoroughly measured when compared directly to spatially accurate, digital orthophotography. Digital orthophotography is imagery that has been mathematically corrected to remove the distortions resulting from the lens, camera system and the tip and tilt of the aircraft during acquisition. In addition, the corrected imagery is geographically referenced to the ground and further corrections for distortions in scale due to changes in terrain elevation are applied. The orthorectification process serves to effectively convert a simple photograph to a map allowing for accurate measurements to be made directly from the image.

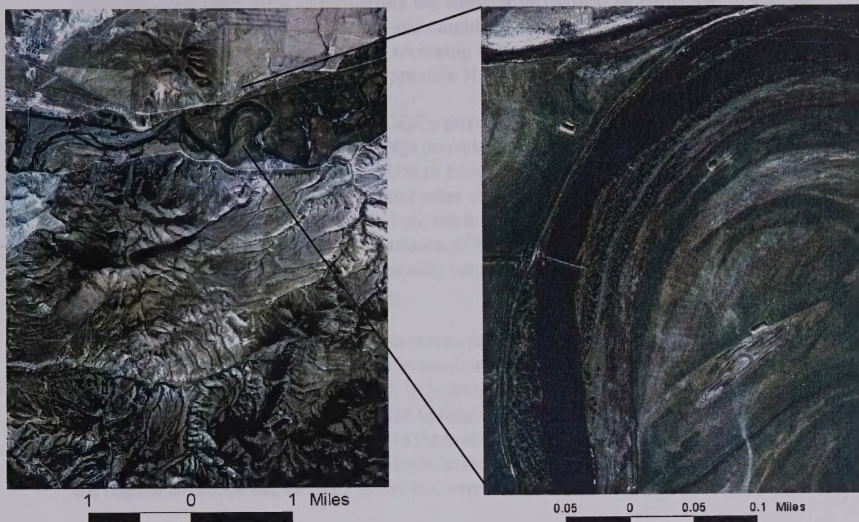
Digital Orthophotography Production

A Statement of Work was developed for digital orthophotography production and submitted for bid. Bid packages were reviewed and a contract was awarded. Original roll film from the NSTC Aerial Photography Archive, along with current United States Geological Survey (USGS) Digital Orthophotographic Quarter Quads (DOQQ), and USGS Digital Elevation Models (DEM) were provided to the contractor. The majority of archival film utilized for this purpose was 1:24,000 scale, natural color photography taken in the late 1970s and 1980s. The historical DOQQs, along with the raw scans were provided by the contractor on firewire drives. A QC review was conducted for image quality and spatial accuracy.

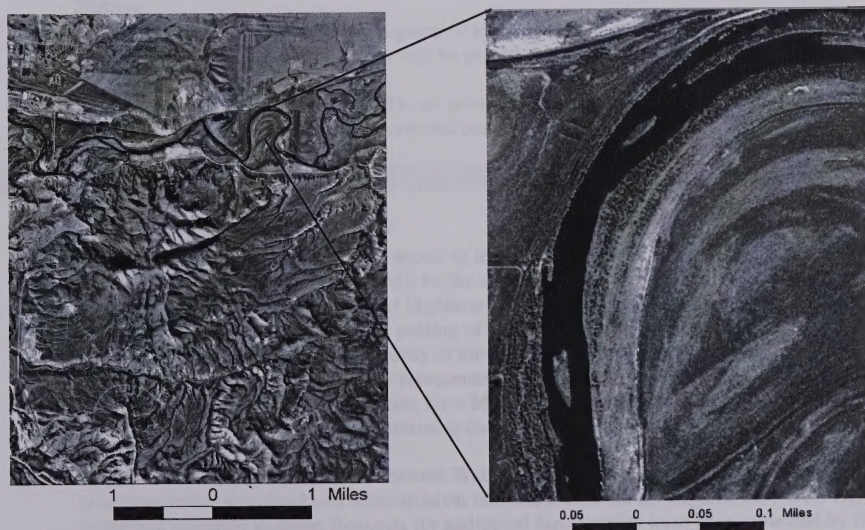
Results

The historical DOQQs were produced for selected areas in Colorado, Utah, and Wyoming and provided to both state and field office users via DVD. An initial attempt was made to provide the imagery over the web via the Bureau FTP site; however the large files size (540,000 kb) of each historical DOQQ made download time prohibitive. The historical DOQQ produced via contract covered basically the same area as the standard USGS DOQQ.

The historical DOQQ was provided in its original natural color format with a ground sample size of 0.46 meters.



The standard USGS DOQQ is a black and white product with a ground sample size of one meter.



A questionnaire concerning the use of the historical DOQQs was sent via e-mail to the DOQQ recipients after a review period of approximately six weeks. Due to workload priorities not all personnel who received the DOQQs participated in the questionnaire.

The historical DOQQs were used in a variety of projects focused on detecting changes in the landscape over time, such as evaluating the cumulative impacts of roads and landscape fragmentation to demonstrate change and cumulative impacts at a local level, route analysis for travel management planning, and accessing surface disturbance as a result of mineral activity on public lands. Please see Appendix H for a complete list of questions and responses.

The recipients found the historical DOQQs provided via this applications of science project extremely useful. The historical DOQQs provided a higher resolution than the commonly utilized sources such as the standard USGS DOQQ or satellite imagery. The temporal differences in the historical DOQQs and other utilized imagery allowed for changes over the last 10 to 15 years to be detected. As both the historical and standard USGS DOQQs are in the same coordinate system, direct comparisons of features could be made. These comparisons could be done both qualitatively by visually inspection and quantitatively by directly overlaying GIS data on the two images.

As indicated in the responses to the questionnaire, the historical DOQQs provided insight into change over time. In the case of route evaluation not only were new routes evident but also the widening of some routes occurred, indicating increased use or a change in vehicle type. Changes in vegetation type and impacts to riparian areas can be evaluated and monitored to see if recreation is causing an impact to these areas. These images, in conjunction with GIS and other data, can then be made available to the public to facilitate a better understanding of the impact of recreation, or other activities, over time.

Once created, the historical DOQQs can be utilized by a variety of resource applications providing a significant return on the original investment made in their creation. And, as in the case in Wyoming, they can be provide to the bureau users on internal servers as well as to the public via the University of Wyoming clearinghouse.

Status

As of the completion of this report, a group of historical DOQQs are in the quality review phase and, pending successful review will be provide to the field for use.

Additional groups of historical DOQQs are planned for production and will be provided to the field for use pending delivery and successful completion of the review process.

Future Options

Pilot Intranet Website

The next step in providing enhanced access to the priceless resources housed within the NSTC Aerial Photography Archive will be the addition of the remaining photo center data contained on the resource scale Mylar flightline index maps. This will involve the digital transfer, quality review, loading, and posting of approximately 450,000 photo centers, making location information for the vast majority of the aerial photography contained within BLM Aerial Photography Archive digitally represented on the Pilot Intranet Website. Aerial photography location data for Colorado, New Mexico, Utah, and Wyoming is scheduled to be posted by February 2004, with the remaining data slated for posting in the spring of 2004.

Based on the responses to the Pilot Intranet Website Questionnaire, the basic functionality needed to gather locational and other archival information on the holdings of the NSTC Aerial Archive is currently in place. Requests for additional functionality have been reviewed by the

project team and ranked with regard to level of difficulty. Please see Appendix I. Based on funding levels, the ranked recommendations will either be implemented or postponed to a later date. Some minor functionality changes that do not require additional funding will be implemented by the website developers upon approval from the project team.

Currently in place at NSTC are resources for data development and processing, software, hardware, storage space, and website programming resources. For the near future, the Pilot Intranet Website will stay internal to the BLM community. However, requirements for making the application available to the public are being explored. To this end a "Phase II" follow up applications of science proposal has been submitted for FY 2004 funding.

Recommendations

With basic functionality in place, improvements ranked, and additional data scheduled for loading, the NSTC Aerial Photography Archive Pilot Intranet Website is well on its way to providing the BLM with access to this important resource. Once fully implemented on a Bureau level, it is recommended that an additional review and comment period be initiated. This additional comment period would evaluate any additional changes in functionality and validate those recommend made during the initial comment period. Based on the results of this review, the Bureau may then consider providing public access to the site, or a similar site with the same basic functionality, through the external internet.

A full review of the steps necessary in converting the Pilot Intranet Website to an external site are beyond the scope of this study. However they would involve the site being tailored to meet ADA requirements and review by Bureau Configuration Management Board and Public Affairs. Bases on the success of the Archive Pilot Intranet Website demonstrated in the applications of science project, it is recommended that the BLM explore the funding necessary to develop and maintain this application.

Aerial Photography

A fundamental goal of this project was to enhance the use of the aerial photography housed in the NSTC Aerial Photography Archive by providing scanned, digital imagery to the field for use in answering scientific and resource questions. Based on the results of the questionnaire, the historical DOQQs are not only of great value to the project for which they were being used, but will also be of value for answering a large variety of land management questions.

During the course of this project the issue of providing archival aerial photography on line arose. The Pilot Intranet Website was the first step in addressing this issue. The aerial photography utilized in producing the Historical DOQQs was down sampled to a low resolution thumbnail image and attached to the associated photo center. The thumbnail images were viewed as an excellent component of the Interactive Mapping Application. To house and serve thumbnails associated with all the photo provided on the fully implemented site would require approximately 100 gigabits of server space. Where high resolution scans of 14 micron per frame of B&W film would require 120 MB (natural color and CIR would require 3 times this space) more than 60,000 gigabits of server space would be required.

Recommendations

There is no doubt that, were all the 500,000 frames of original aerial photography contained in the NSTC Aerial Photography to be scanned and made available for download, BLM users, other Government Agencies, and the public would make extensive use of this incredible resource. The reality, however, is that this would require approximately \$1,300,000.00 for high resolution scanning alone, with addition costs for hardware, and data and website maintenance. A full review of the steps necessary to facilitate the online serving of the aerial photography contained within the NSTC archive are beyond the scope of this study.

However, recommendations with respect to future systematic scanning of the archival photography can be made. Of paramount consideration is the lifespan of the film. Currently the film is being stored in cool dry conditions. The majority of the film is scheduled to be moved to a climate controlled storage area starting in January 2004. Given the historical storage conditions for the film and based on manufacturer projections, the B&W film should have a lifespan of 50 years. A life span of 45 years is estimated for the natural color. Of most critical concern is the CIR film. Tests indicate that as the film ages it begins to lose density, and concerns about duplication arise as it becomes difficult to compensate for color loss in processing. The cyan layer is the first of the three emulsion layers to deteriorate. This deterioration can begin to occur after 25 years. The oldest color inferred film contained in the archive is now reaching 27 years.

When evaluating priorities for systematic scanning, field requirements must also be considered. Most BLM resource specialists require the most current information to effectively do their daily mission. Thus beginning systematic scanning with recent photography in high priority areas would likely be most effective for field offices. This approach would require BLM state and field offices to determine priority areas and funding strategies for archival scanning. While such strategies are currently being discussed they are not in place across the bureau.

Acknowledgements

Since the inception of this project, there has been a high level of support from a great number of individuals both within NSTC and the BLM as a whole. Their support, ideas, time, and efforts continue to be required and they are greatly thanked.

A special thank you goes to the NSTC Branch of Photogrammetric Applications for their tremendous knowledge of the NSTC Aerial Photography Archive and their assistance in gathering materials for and quality control of the contracted materials.

Recognition also goes to the NSTC Branch of Resource Systems & Remote Sensing/GIS Applications for their assistance in project design, assistance with task orders, and to Wendy Bullock for her expertise in ArcIMS and database design. Very special recognition and thanks goes to Devon Williford, contractor, with out his support and diligent work on the design and implementation the Pilot Intranet Website would not exist. His creativity, patience, timeliness, and sense of humor are greatly appreciated.

Appreciation is also extended to the Applications of Science Initiative for funding of this project and to NSTC Center Director for his support.

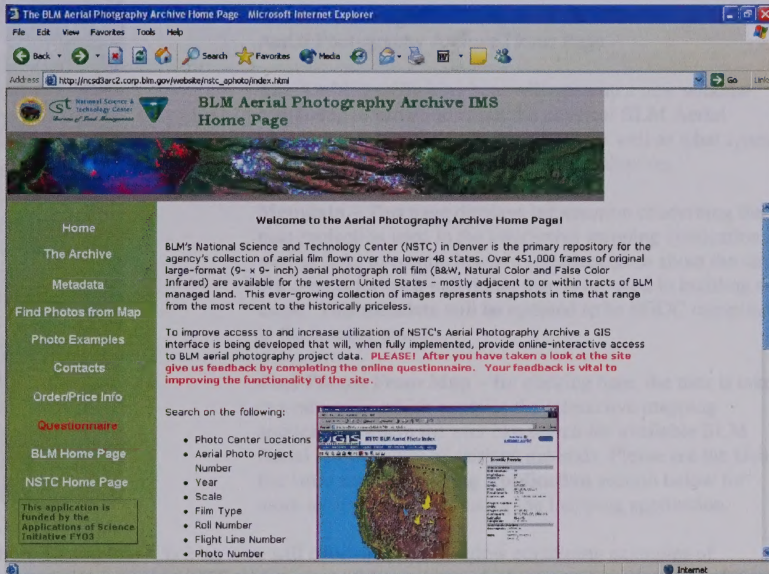
Appreciation is extended to all those who participated in both the website and DOQQ questionnaire.

The Oregon State Office (ORSO-BLM) was an invaluable resource used in helping design, develop, and implement the BLM Aerial Photography Archive IMS application. Not only did their office, in particular Ms. Shelley Moore, provide the hardware and software used for hosting the internet mapping components of the application, but they were also able to provide help and assistance to rapidly customize the application to best fit our needs. It would be difficult to overstate the importance of the cross-training and time they dedicated to us during development of this application. And to Liz Peck in the New Mexico State office for having the foresight to start digitizing their flightline indexes years ago and letting the project benefit from her experience.

Appendix A: Help Documentation

Bureau of Land Management - National Science and Technology Center (NSTC)

BLM Aerial Photography Archive Internet Mapping Service (IMS)



This document is a comprehensive guide to the BLM Aerial Photography Archive IMS Web Site. It contains a detailed walk-through of the functionality and information associated with the informative home page, as well as the interactive mapping portion of this web site which is essentially used to search, map, and find available BLM Aerial Photography. It attempts to answer any questions as to how to use this web site, as well as a quick reference guide on how to find available aerial photography by using the website. This help document is divided into three sections, listed below:

1. Finding Information on the Home Page
2. Using the Interactive Mapping Application
3. Quick Reference Guide

1. Finding Information on the Home Page

The BLM Aerial Photography Archive Home Page is the starting point for exploring information concerning the purpose and content of the aerial photography archive application. Here the user will find information concerning the BLM Aerial Photography Archive, and why an interactive mapping application is being developed to complement the physical archive. Also displayed here are comments concerning the progression of development of the site, other partners who are involved in development of the application, and information encouraging users to submit their comments on the site using the online questionnaire.

On the left side of the Home Page, the user will find a **table of contents** which addresses various information specific to this site, as well as links to other areas of interest. By clicking on the words in the table of contents, the user is taken directly to an area or a new window opens up displaying a new content page.

Home
The Archive
Metadata
Find Photos from Map
Photo Examples
Contacts
Order/Price Info
Questionnaire
BLM Home Page
NSTC Home Page

Home – Clicking here will take the user back to the BLM Aerial Photography Archive Home Page

The Archive – Clicking here will open up a new window containing information about the physical BLM Aerial Photography Archive from the NSTC, as well as what types of film are stored and available for reproduction.

Metadata – This page displays information concerning the map projection used in the interactive mapping application, as well as links to comprehensive metadata (data about the data) documents for each individual map layer used in building the maps. This metadata will be updated to be FGDC compliant in the coming months.

Find Photos From Map – By clicking here, the user is taken to a new page which contains the interactive mapping application, where the user can search for available BLM Aerial Photography by various methods. Please see the **Using the Interactive Mapping Application** section below for more information about using the mapping application.

Photo Examples - Clicking here will open up a new window containing examples of photography from the NSTC that are part of the archive which is stored and available for reproduction in Denver.

Contacts - This page displays email and phone contact information for comments and questions concerning the Aerial Photography Archive IMS, as well as ordering photography from the archive.

Order/Price Info - This page displays information for ordering photography stored in the BLM Aerial Photography Archive, and also includes the BLM Aerial Photography Archive Reproduction Price List.

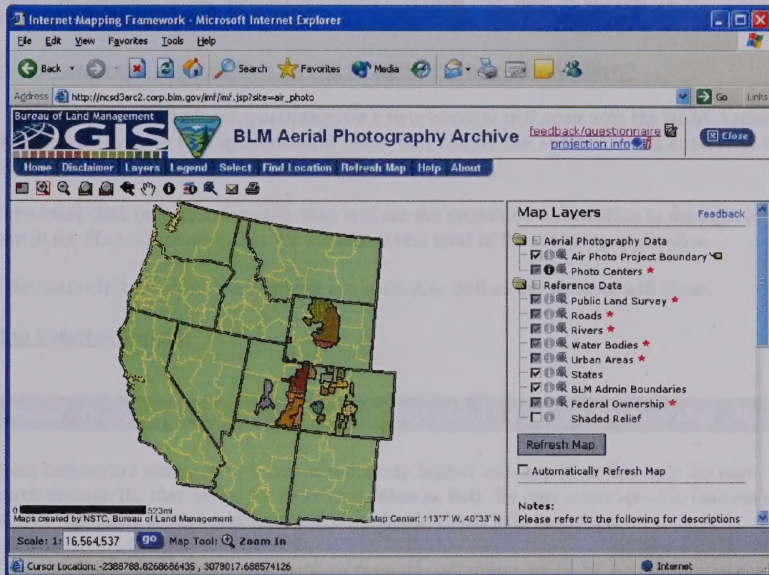
Questionnaire – Clicking here will open up a new window containing the aerial Photography Archive IMS Questionnaire. The questionnaire is used to gather information and comments from users in a structured format, so that recommendations on changing the functionality or content of the website can be determined in a useful fashion. When the user submits or finishes the questionnaire, the responses are stored in a web-based form and can be examined by the project team.

BLM Home Page – Clicking here will open up a new window containing the BLM Home Page.

NSTC Home Page – Clicking here will open up a new window containing the National Science and Technology Center (BLM) Home Page.

2. Using the Interactive Mapping Application

The BLM Aerial Photography Archive Internet Mapping Service (IMS) is the interactive mapping application designed for exploring the large BLM Aerial Photography Archive. This web application uses several modern Geographic Information Systems (GIS) and internet server software packages to provide the user with the ability to use maps to query available photography by physical location. When the user first enters the mapping component of the application they see this screen:



This window can be divided into five sections, each with its own purpose and functionality:

The Top Banner – The top banner displays title information, a link to projection information and feedback form

Map Function Buttons – These buttons provide the user with search/selection capabilities, additional help, and lists additional information about the map.

Map and Map Toolbar – This is the main map canvas and contains tools to navigate and/or identify features on the map.

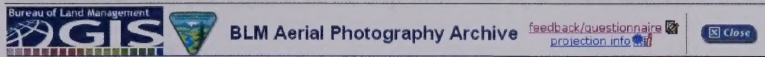
The Bottom Toolbar – This toolbar provides current scale information about the map, and provides the user the capability to zoom in and/or manipulate the scale rapidly.

Map Information Box – This box displays legend/layer information used in the map, as well as other map information such as queries, selected features, and map help.

This document will also divide the mapping window into five sections, in order to help the user understand the full functionality of each part of the screen. The five sections are explained in depth below.

**BLM Library
Denver Federal Center
Bldg. 85, OC-521
P.O. Box 25047
Denver, CO 80225**

The Top Banner:



The Top Banner is used to explain the title of the mapping component of the website, list the projection information used in the mapping component, as well as provide a link for the user to provide feedback to the appropriate project personnel who may be developing or administering the website.

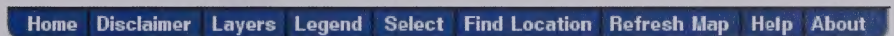
For this particular site the title is the “BLM Aerial Photography Archive.”

If the users click on *feedback/questionnaire* a new window will open with the BLM Aerial Photography Archive IMS questionnaire where they can fill out and/or provide comments to the project team.

If the users click on *projection info*, they will see the projection information to the right of the map in the *Map Information Box* for the map layers used in the mapping application.

If the users click on *close*, the mapping application as well as the window will close.

Map Function Buttons:



These buttons are used to toggle between the map legend and map layer list, help the user search through the map layers for individual features, help the user select specific features on the map through a spatial selection, and provide additional help reference.

If the user clicks on **Home**, a new window pops up containing the BLM Aerial Photography Archive Home Page.

By clicking on **Disclaimer**, the user will see the following information in the *Map Information Box*: (No warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual or aggregate use with other data. Original data were compiled from various sources. This information may not meet National Map Accuracy Standards. This product was developed through digital means and may be updated without notification.)

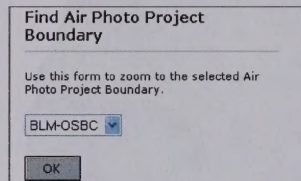
By clicking on **Layers**, the user will see all of the layers that make up the map, visible and non-visible, in the *Map Information Box*. This allows a user to turn layers on/off, and to make a layer active for identifying it or for selecting features. More of this functionality is described in the *Map Information Box* section below.

By clicking on **Legend**, the user will see all of the layers that make up the map, described by the color and symbol displayed on the current map, in the *Map Information Box*.

By clicking on **Select**, the user will see all of the geometric options for selecting a feature from the active layer (see **Layers**), on the map, in the *Map Information Box*. These include:

- Select by buffer
- Select by layer
- Select by attribute
- Select by point
- Select by box
- Select by polygon

Then the user can select features on-screen by creating a shape. The application will then select all features from the active theme and create a report in the *Map Information Box* listing the results. For example, a user could select “select by polygon,” then draw a polygon on screen, and a report listing all photo centers would then be generated and displayed in the *Map Information Box*. More of this functionality is described in the *Map Information Box* section below.



A screenshot of a dialog box titled "Find Air Photo Project Boundary". Below the title bar, it says "Use this form to zoom to the selected Air Photo Project Boundary." There is a dropdown menu with "BLM-OSBC" selected. At the bottom is an "OK" button.

By clicking on **Find Location**, the user will see a list of categories to zoom into in the *Map Information Box*. These include:

- Latitude/Longitude Coordinate
- State
- BLM Admin Boundary
- Air Photo Project Boundary

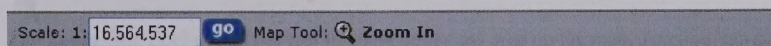
For example, a user could select “state” and then select the specific state from a list of attributes, and the map will zoom into the boundaries of that selected state. Or if a user knows a specific lat/long coordinate, he/she can enter that coordinate in and the map will zoom to that coordinate.

If the user clicks on **Refresh Map**, the map will refresh to the current geographical extent.

If the user clicks on **Help**, an additional help document discussing tabs, buttons, and tools, will be displayed in the *Map Information Box*.

If the user clicks on **About**, the following help box discussing how to find available BLM aerial photography photo centers will be displayed in the *Map Information Box*:

The Bottom Tool Bar:



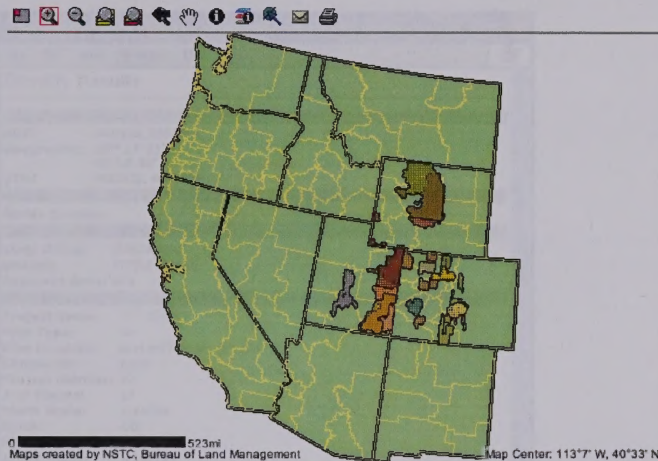
A screenshot of the bottom toolbar. It includes a scale input field showing "Scale: 1: 16,564,537", a "go" button, a "Map Tool:" label, a magnifying glass icon, and a "Zoom In" button.

This toolbar is used to display and change the map scale. It is designed to help users who want to view information at specific scales.

The **scale** window above displays 16,564,537. This would be the current scale of the map displaying in the map window. Here, users can type in any specific scale that they would like to see in the map window at and select **go**. By pressing go, the map redraws at the specific scale that is entered, geographically in the center of the map that is in the map window. Remember, this window always displays the current scale of the current map in the map window.

By selecting **Zoom In**, the user can zoom in to a specific portion of the map, geographically in the center of the map that is in the map window.

Map and Map Tool Bar:



The Map and Map Tool Bar display the map “canvas” and offer the user a set of tools to navigate on the map. Above, we see that the map displayed is of the western United States, along with an appropriate scale bar, a statement concerning the creators of the map, and the center map coordinates. The scale bar and text is always displayed on each map that is created or displayed in this window. A North Arrow is also displayed on the map canvas, once the user zooms in or creates a new map.



The **Index Map Tool** toggles on/off the index map from the *Map Information Box*. The user does this by clicking on the tool (selecting it) from the toolbar.



The **Zoom In Tool** allows the user to zoom in to any area on the map. The user can zoom in by clicking on the tool (selecting it) from the toolbar, and then clicking anywhere on the map.



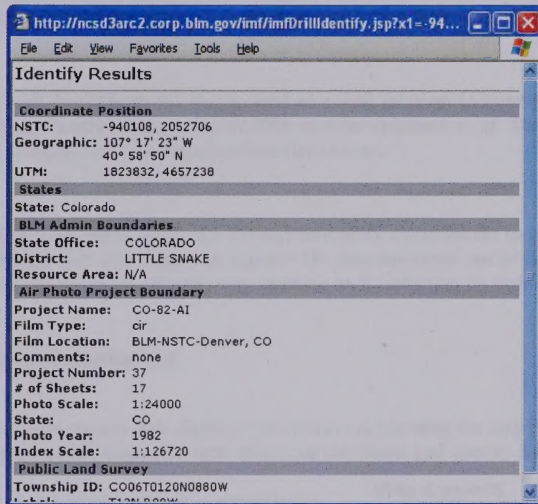
The **Zoom Out Tool** allows the user to zoom out to any area on the map. The user can zoom out by clicking on the tool (selecting it) from the toolbar, and then clicking anywhere on the map.



The **Zoom to Full Extent Tool** allows the user to zoom out to the full extent of all the map layers. In the case of the BLM Aerial Photography Archive IMS, the full extent is the Western United States. The user can zoom to the full extent by clicking on the tool (selecting it) from the toolbar.



The **Zoom to Active Layer Tool** allows the user to zoom out to the full extent of the selected layer. This will change the map extent to the extent of a chosen layer. For example, the extent of the "States" layer would be different then that of the "photo center" layer. The user can zoom to the full extent by clicking on the tool (selecting it) from the toolbar, and then selecting one of the layers from an automatically generated list.



The **Last Extent Tool** changes the map extent to the extent that it was before the last extent change. The user can zoom to the last extent by clicking on the tool (selecting it) from the toolbar.



The **Pan tool** is used to move the area shown in the map window to the left, right, up or down. This is accomplished in two ways: Simply click on the map, and the map will be centered at the location you click **or** drag the map by "left clicking" the mouse cursor, keeping the left button depressed, dragging the map window until the adjusted area of interest is displayed. When the mouse button is released, the map will redraw.



The **Identify Tool** is used for reporting. When you click on the map with an identify layer active, the features at the location selected will be displayed in the *Map Information Box*. The name of the active identify layer is displayed in the status bar under the map. To set a

different identify layer, open the layer folders window using the **LAYERS** tab, and click the identify icon beside the layer that you want more information about.



The **Drill Down Identify Tool** displays information about each visible layer at the map position clicked. Shown below is an example of a report screen for the drill down identifying tool. Some sites display information about layers that are not visible too. To use, simply click on the tool, click the map and view the results in the *Map Information Box*.



The **Select Tool** displays results in the *Map Information Box* for the point clicked or the rectangle that you draw on the map. The user can select features by clicking on the tool (selecting it) from the toolbar, and using the selection criteria to draw points or a rectangle on the map.



The **E-mail Tool** allows the user to send an e-mail message to someone with an attachment containing the map image in Adobe PDF or other graphic format. The user can use the e-mail tool by clicking on it (selecting it) from the toolbar.



The **Print Tool** opens a form for the user to specify a title for the map and choose a map scale for a printed map, and creates an Adobe PDF document that can be saved or sent to a printer. The user can access the print tool by clicking on it (selecting it) from the toolbar.

The Map Information Box:

The Map Information Box displays information concerning the map legend, allows the user to turn layers on/off, displays return values for selections and queries done on map layers.

In the "Map Layers" graphic to the right the **checkbox** allows the user can select which themes are to be turned on/off in the mapping window (also referred to as the map canvas). In this case the user has chosen to view Air Photo Project Boundaries, States, and BLM Administrative Boundaries.

The "i" designates which theme is identifiable on the map, the active identify layer. For example, here the "i" theme here is "Photo Centers." Clicking on the identify tool from the toolbar above the map will allow the user to get information about any photo center on the map. The user can have only one theme designated identifiable at one time. The user can change which theme is identifiable at this menu at any time.

Map Layers

[Feedback](#)

- ☐ Aerial Photography Data
- ☒ Air Photo Project Boundary
- ☒ Photo Centers *
- ☐ Reference Data
- ☐ Public Land Survey *
- ☒ Roads *
- ☒ Rivers *
- ☒ Water Bodies *
- ☒ Urban Areas *
- ☒ States
- ☒ BLM Admin Boundaries
- ☒ Federal Ownership *
- ☐ Shaded Relief

Refresh Map

☐ Automatically Refresh Map

To the right of the “i” designation is the blue/green **active theme selection**. Here none of the layers are active, which means the user cannot use the **Select Tool** from the toolbar. A theme is made active by clicking on the button to the right of the “i” in the Map Layer List. After a theme is made active, features from this theme can be graphically selected using the **Select Tool** from the map toolbar. The user can have only one theme active for selection at one time. The user can change which theme is active for selection in this menu at any time.

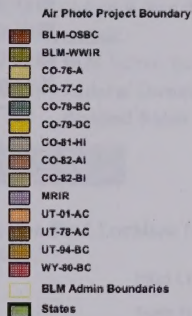
The **red asterisk** means that the layer **cannot be made visible** at the present map scale. If users click on the red asterisk, they will zoom in to the maximum scale at which that individual layer is visible. The number of layers that are not visible may change whenever the user zooms in/out. For example, the shaded relief for this application is visible at the present scale, but it is not visible if the user zooms into a scale of 1:30,000.

The **yellow tag** gives the user the option to turn the labels for this layer on/off.

The user can also e-mail the project contact for this application by clicking on the **Feedback** text.

The **Map Legend** is also displayed in the Map Information Box. The user can click on the **Legend** button from the Map Function Menu and see the map legend at any point.

Map Legend



Identify Results

Air Photo Project Boundary

Project Name: CO-82-AI
 Film Type: cir
 Film Location: BLM-NSTC-Denver, CO
 Comments: none
 Project Number: 37
 # of Sheets: 17
 Photo Scale: 1:24000
 State: CO
 Photo Year: 1982
 Index Scale: 1:126720

Coordinate Position

NSTC: -1068568, 2069243
 Geographic: 108°50' W
 40°58' N
 UTM: 1692700, 4634437

Results from queries, searches, and selected sets are also displayed in the Map Information Box

Example: Selection Set information displayed in the Map Information Box.

Example: Identify Results using the Identify Tool displayed in the Map Information Box.

Example: Select By Attribute Tool displayed in the Map Information Box.

3. Quick Reference Guide

In this section we will go through a few searches that utilize the interactive mapping application:

Problem: Need to find the list of aerial photography projects that have been archived inside the Grand Junction BLM Field Office.

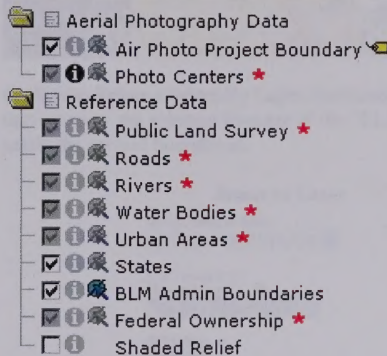
Solution: Select all the Aerial Photography Project Boundaries that are within the BLM Admin Boundary for Grand Junction.

Steps:

1. Make the BLM Admin Boundaries theme an Active Selection Theme by clicking on the blue/green figure to the right of the “i” for BLM Admin Boundaries.

Map Layers

[Feedback](#)



Refresh Map

2. Click on **Find Location** from the Map Function toolbar, and select “BLM Admin Boundary.”

Find Location [HELP](#)

Zoom To:

- [Latitude/Longitude Coordinate](#)
- [State](#)
- [BLM Admin Boundary](#)
- [Air Photo Project Boundary](#)

This menu is used to set the extent of the map using query tools. Select one of the following options, and the map extent will change to show the area that you have selected.

3. Select Grand Junction from the list of BLM Admin Areas. Click on OK. The map will then zoom to the Grand Junction BLM Admin Area extent.

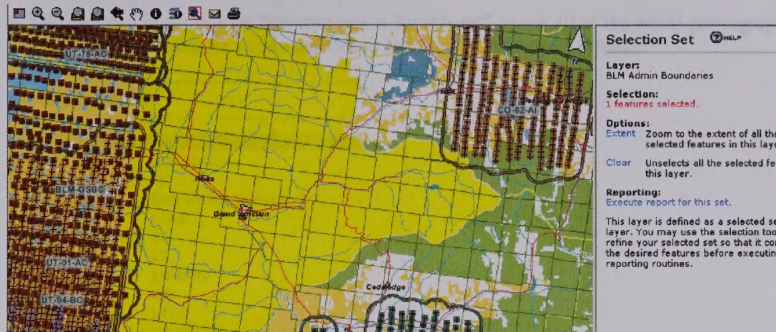
Find Resource Area Boundary

Use this form to zoom to the selected Resource Area Boundary.

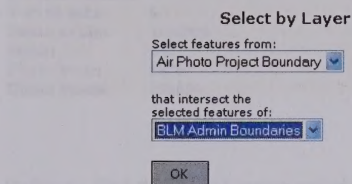
GRAND JUNCTION

OK

4. Use the select tool from the map toolbar and select the middle of the screen. This will by default select the Grand Junction BLM Admin Area.



6. Use the Select – Select By Layer functionality to Select All “Air Photo Project Boundaries” that intersect the selected features of the “BLM Admin Boundaries” layer. Click “OK” to select the project boundaries.



7. The six project boundaries that lie within the BLM Admin Boundary for Grand Junction are then selected. This report screen explains what has been selected:

Selection Set
? **HELP**

Layer:
Air Photo Project Boundary

Selection:
6 features selected.

Options:

Extent Zoom to the extent of all the selected features in this layer.

Clear Unselects all the selected features in this layer.

Reporting:
Execute report for this set.

This layer is defined as a selected set type of layer. You may use the selection tool to refine your selected set so that it contains the desired features before executing the reporting routines.

8. The user can now click on “execute report for this set” to see all of the aerial photography project boundaries that lie within the Grand Junction BLM Admin Office.

Query Results	
Air Photo Project Boundary	
Project Name:	CO-82-AI
Film Type:	cir
Film Location:	BLM-NSTC-Denver, CO
Comments:	none
Project Number:	37
# of Sheets:	17
Photo Scale:	1:24000
State:	CO
Photo Year:	1982
Index Scale:	1:126720
Zoom to this feature	
Project Name:	UT-78-AC
Film Type:	natural color
Film Location:	BLM-NSTC-Denver, CO
Comments:	none
Project Number:	9
# of Sheets:	5
Photo Scale:	1:24000
State:	UT
Photo Year:	1978
Index Scale:	250000

Problem: Find the Photo Centers and identify them on the map for Project CO-79-DC.

Solution: Select the project “CO-79-DC” from the Find Location – Air Photo Project Boundary List.

Steps:

1. Select Air Photo Project Boundary from the Find Location list. The Find Location list can be found by clicking on **Find Location** in the map function menu above the map.

Find Location HELP

Zoom To:

- [Latitude/Longitude Coordinate](#)
- [State](#)
- [BLM Admin Boundary](#)
- [Air Photo Project Boundary](#)

This menu is used to set the extent of the map using query tools. Select one of the following options, and the map extent will change to show the area that you have selected.

2. Choose CO-79-DC from the Project Boundary list. Select OK to map the extent of project boundary for CO-79-DC.

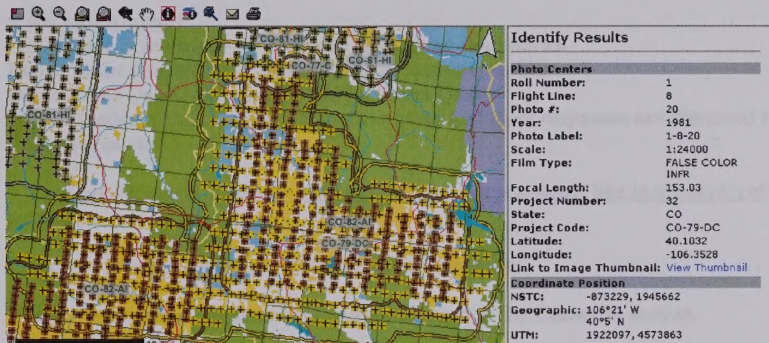
Find Air Photo Project Boundary

Use this form to zoom to the selected Air Photo Project Boundary.

CO-79-DC

OK

3. By clicking on **Legend** on the map function toolbar, we can see that the CO-79-DC photo centers are orange colored with a cross. Next, click on the **Identify** Tool above the map in the map tool list. This will allow the user to identify (bring up information) for any of the photo centers by clicking on them directly.



Identify Results

Photo Centers	
Roll Number:	1
Flight Line:	8
Photo #:	20
Year:	1981
Photo Label:	1-8-20
Scale:	1:24000
Film Type:	FALSE COLOR
Focal Length:	153.03
Project Number:	32
State:	CO
Project Code:	CO-79-DC
Latitude:	40.1032
Longitude:	-106.3528
Link to Image Thumbnail: View Thumbnail	
Coordinate Position	
NSTC:	-873229, 1945662
Geographic:	106°21' W 40°5' N
UTM:	1922097, 4573863

To see a scanned thumbnail of the image, click on "View Thumbnail" from the Identify Results Report.

Appendix B: Results of Website Questionnaire

Aerial Photography Archive IMS Applications of Science Review Process Responses and Comments Used Gathered During Review of the Website November 12, 2003

128 Total Individual Responses to the Aerial Photography Online Questionnaire
Period of Review: 8/27/2003 to 11/5/03: 70 days

Overview of Responses to Non-Comment questions:

Website Improvement

1. Are there additional base data layers that would assist you in finding BLM archival photography?

Response: 77 responded Yes, while 41 had no response.

If yes, which layers?

USGS Quad Boundaries – 24 checked USGS Quad Boundaries

Digital Raster Graphics – 19 checked Digital Raster Graphics

Digital Ortho Quads – 16 checked Digital Ortho Quads

Other – If other, please explain: 18 checked other and these responses are discussed in the Comment section.

2. Are there additional queries or other functionality that you would like to see as part of the website?

Response: 17 responded Yes, while 111 had no response.

If yes, please explain. These responses are discussed in the Comment section.

3. Would you like to download a shape file or .e00 file that contains photo center locations, scale, film type, etc.

Response: 41 responded Yes, 17 responded No, while 60 had no response.

If so, which type of download would be of most use?

Download Photo Centers By:

Complete Aerial Photography Project – 18 selected Complete Aerial Photography

BLM Field Office – 13 selected BLM Field Office

State – 10 selected State

4. Would you like to be able to download digital versions of BLM archival photography from this site?

Response: 87 responded yes, while 41 had no response.

If so, at what resolution? These responses are discussed in the Comment section.

Aerial Archive

5. Have you ordered aerial photography from NSTC's Aerial Photography Archive in the past?

Response: **37 responded yes, 22 responded no, while 59 had no response.**

If so, how often do you order aerial photography from the BLM?

More than 4 Times A Year – **25 selected More than 4 Times A Year**

2 to 4 Times a Year – **2 selected 2 to 4 Times A Year**

Once a Year – **5 selected Once a Year**

Once Every 2 Years - **4 selected Once Every 2 Years**

Once Every 5 Years - **1 selected Once Every 5 Years**

6. What type of product did you receive?

Paper Prints - **30 selected Paper Prints**

Film Positives - **0 selected Film Positives**

Digital Scans - **2 selected Digital Scans**

Enlargements - **3 selected Paper Prints**

Other - **1 selected Other**

7. What type of land management questions did this photography help you solve?

Vegetation Mapping – **22 selected Vegetation Mapping**

Transportation Studies – **2 selected Transportation Studies**

Questions of Trespass or Right of Way – **5 selected Questions of Trespass or Right of Way**

Other - Please Explain - **8 checked other and these responses are discussed in the Comment section.**

8. Would you like to order photography on line?

Response: **84 responded yes, while 44 had no response.**

Would this website provide the information needed in your photo search?

Response: **83 responded yes, 1 responded no, while 44 had no response.**

If No, Please Explain - **These responses are discussed in the Comment section.**

9. How would you use digital photography to answer resource management questions?

Please Explain - **These responses are discussed in the Comment section.**

10. Please feel free to add any additional comments or questions:

Please Explain - **These responses are discussed in the Comment section.**

Where the Responses Came From (BLM Office Breakdown)

State Offices: ORSO (4), AZSO, IDSO, WYSO, CASO

Field Offices: Prineville, OR, Salem, OR, Eugene, OR, Moab, UT, Rawlins, WY, Boise, ID, Shoshone, ID, St. George, UT, Cedar City, UT, Tonopah, NV (4), Fairbanks, AK, Worland, WY

Other Offices: Denver, CO (2)

Overview of Responses to Comment questions:

Are there additional base data layers (besides USGS Quad Boundaries, DRG's, and DOQ's) that would assist you in finding BLM archival photography?

1. 7.5 and 15 degree quad names with indexes to Landsat and other image sources
2. Place names
3. Project Development/Location
4. Watershed Boundaries with Label
5. More Hydro Detail
6. More Transportation Detail
7. Section Lines & Section Number
8. Stream Names should be added
9. GNIS and the actual air photos
10. All of the above layers would be "value-added", meaning they would be great to have, but I believe we can find available photos from the layers already identified. The real key to finding these are the PLLS. So if you can add the above layers great, but if not, the layers identified will work.
11. It would be useful to have an index of coverage for an area so we could see how far back the coverage existed.
12. GCDB down to the parcel level
13. Allotment Boundaries, District Boundaries
14. Mountains, towns, streams, etc..
15. Identify corner locations and boundary lines.
16. It could help locate the public land survey system
17. It would be very helpful to have the GCDB linework as a base (where available), for land surveying / trespass / boundary location information
18. It would also be valuable to have a GIS like link to MTP data that could be overlaid onto a photo. Several years ago I thought this is where the BLM was headed but we never seemed to get there.

Are there additional queries or other functionality that you would like to see as part of the website?

1. Query by Field Office.
2. I haven't looked at the site in depth, but the vintage of photography is an important query. Perhaps that is already there.
3. Sections, when zooming in to an area smaller than a township. Sections would look good in light gray. Ability to show the extent of a single photo when zoomed in to an area smaller than a township. This would be best to do one photo at a time so as not to clutter. Try using a dashed line to show extent.
4. Labeled Roads and place names would be helpful reference layers to orient the user to where they are. If the data was projected as Geographic, the IMS layer could be integrated with the National Map through ArcExplorer Java.
5. A query where you can plug in quad id or quad name and then have the program zoom to that area of interest.
6. Would like to see locations of mines, mining related disturbances, fluid and solid mineral lease boundaries, etc.
7. Locations of proposed mining plans and notice level operations, to verify past and present disturbances
8. A query based on township and range would be helpful.
9. Search by area of interest for all of the photography in that area.

10. It would be helpful to have a "Search" box that would allow the user to search for a specific location without using the zoom tool.
11. Alaska
12. Having the image plotted in lieu of paper prints from the film, is a helpful cost savings.
13. The 24k DRG's and DOQQ's may be helpful when zoomed in to scales appropriate for viewing them.
14. You should add a query by GNIS names
15. Is there a way to show coverage for a particular area by year? This assumes that some areas will have multiple years of coverage.

At what scale would you like to be able to download digital versions of BLM archival photography from this site?

1. 1:24000
2. > 150 dpi, though 300 dpi works very well
3. Start with 300 dpi, 24 bit color
4. At least 300 dpi
5. 300 DPI
6. The finest resolution possible. Even if there are some hardware limitations on downloading, the next step would be to be able to identify photos required, and then have them burned onto a CD and sent to the requester for loading into local GIS systems
7. Option of picking resolution depending on what's available

What other type of land management questions or resource management questions (besides, Vegetation Mapping, Transportation Studies, or Trespass/Right of Way questions) did this photography help you solve?

1. Oil and gas E & P activity
2. Vegetation and water rights
3. On screen vegetation assessment, hardcopy printout for project folders and field work, stereoscopic photo interpretation.
4. Forest inventory
5. Wildlife habitat assessment
6. Vegetation mapping
7. We have used them for cultural resource evaluations and to assist in locating paleontological resources.
8. Transportation Studies
9. Vegetation mapping
10. Boundary locations. Road locations. Trespass issues.
11. I could go on for a long time on this. Let's just say that photo coverage, particularly digital, would be extremely useful to the issues I deal with which include: watershed hydrology, riparian management, contaminant transport evaluation, flood studies, hazmat characterization, project planning and development, trend analysis etc.
12. Questions of Trespass or Right of Way
13. Questions of Trespass or Right of Way
14. Record changes in vegetation, first occurrence of physical features (building, roads, etc), extent of fires, perhaps pollution sources (IR).
15. Digital photography could help us answer questions about routes (did that route exist in 1976?), and vegetation changes (PJ encroachment & Ponderosa Pine vegetation changes.
16. We use old photos which we've scanned ourselves and geo-referenced mainly for vegetation change detection.
17. In Mapping Sciences, Oregon State Office, we obtain prints at the behest of the district offices. They have a variety of uses. But you would need an automated order form.

We also get enlargements, diapositives, even scans. The photography is used for lots of natural resource mapping projects, including change detection, archeology, photogrammetry, geology, soils, etc.,

18. Mining-related disturbances would be a great use of this technology.
- to verify past and present disturbances. Verify actual locations of proposed actions.
19. Planning, capacity limitations
20. Inquires for the public and district offices.
21. Tract location. Trespass issues. Well locations. Vegetation studies. Many others
22. Time series modeling for a multitude of applications.
23. I'm the GIS coordinator for the Alaska Fire Service and the Northern Field Office, so I would always use it digitally, I would geo-reference it (ortho is not always necessary), and use it for base maps and for feature extraction & heads up digitizing.
24. Identify transportation networks for ground verification.

Would this website provide the information needed in your photo search?

1. System right now is too slow to select with interactive map
2. It is always nice to be able to document condition of resources at specific points in time, especially when investigating violations. It also helps to evaluate risks to resources that are the result of existing environmental conditions. My resource inventory information is UTM NAD 27 based, if it is possible to convert the digital imagery to that system it would be even more useful.
3. I could not get into specific areas when I gave the coordinates that were requested.
4. Hope it can scale up. Faster wouldn't hurt.
5. This is one of the best and potentially most valuable products I can think of for NSTC to be doing. The automated use of aerial photography is becoming more common in field offices, particularly with the newer employees coming from universities. The problem we have in field offices is the time it takes to scan photos in and orthorectify them. The easy access to older photos would be priceless.
6. This will be a great tool for us.
7. Although it may not be the primary purpose of this site, the most valuable service would be the ability to view and download photos on line. There is at least one internet site that has this capability now (USGS I think) but the ultimate resolution is not optimal. I'm sure it would take quite a while to digitize all of the photos on file but starting with the most recent and working back in time while saving photos that others have paid to have digitized/printed would seem a logical approach.
8. I would like to be able to order photography for my entire field office with one click.
9. Photo interpret and compare photography to DOQs, screen digitize change onto DOQs, screen digitize natural resource data onto DOQ from what I see on the digital photography.
10. I use photography from the Alaska archive for GIS support in fire operations and planning, land use planning, land cover mapping, Alaska's missing

Please feel free to add any additional comments or questions:

1. If you haven't done so you should review the Univ. of Arizona's ARIA web site for design and response considerations. <http://aria.arizona.edu>
2. Issues of invasive species and looking at trends over time. It would also be useful as an inventory in areas where we lack information on vegetative cover. This is great!!
3. This web site is a good start for on-line photo project display and ordering of prints or images.
4. Operational needs on the District would require more detailed information as mentioned above.
5. Section numbers would be useful at high zoom levels
6. Water' (Federal Ownership) does not match 'Water Bodies' in the legend
7. Local Government, Other Federal, and DOE look the same in the legend

8. Urban and BOR colors are too similar
9. The tilt of the projection is very distracting (most noticeable in the Northwest corner)
10. Ownership does not match PLSS
11. Yellow lines are extremely difficult to see on the white background.
12. Water bodies need the outline in the map to match the legend - streams should also have the same symbol.
13. Red asterisks in the layer legend are not defined
14. Legend entry labels should be singular.
15. Urban labels should be placed to the upper right instead of centered
16. Highways need labels for location clues
17. Labels should be visible at smaller scales
18. Users unfamiliar with our projects will want to find photography by picking a point or area known to them. A tool to zoom to a specific township would be useful. A way to center the map to a quad or coordinate would provide a common reference.
19. Finally, the background was too strong and competed with the air photo projects. If you have already made adjustments to the background, perhaps they need to be adjusted further.
20. Also, It was not possible for me to figure out which project name went with which project. Could the project names come in with the same color as the project boundary and centers?

I zoomed in on an area in Utah that has several overlapping projects. The projects came in with colors that were not that easy to differentiate. Can the colors be fixed so they are sure to contrast with adjacent projects?

21. I like the thumbnail feature, for a quick preview. I suspect but could not verify from the web page that the images are oriented with north to the top, it would be helpful to know for sure when viewing the photo. This is an excellent asset. I hope you will use the Bighorn Basin as your next test area.
22. I haven't ordered aerial photography from NSTC because I have no idea what is available. Once we know what is available I suspect you will have a very great deal of use, particularly if it's "easily" downloadable. The uses for this type of aerial photography are almost limitless. One of the most valuable applications would be for change detection work.
23. I was unable to actually see an aerial photo, only the land status colors showed
24. The coordinate information (both the Lat/Long coordinates and UTM) is off. The lat/long is reading 54 x 143 when it should be closer to 37 x 113. The UTM is saying zone 5 when it should be 12. Also, what does the red asterisk next to items in the legend mean? I clicked on the one by Photo Centers and it took me to Northern Utah. There is no explanation on the website for this.
25. When zoomed way in, photo center shows in lat/lon; "coordinate position" also in lat/lon but they are not the same. It is not clear to what the term "coordinate position" applies. The cursor location shown in the lower left screen might be more useful to more people if it read in lat/lon vs UTM.
26. Find photos from map tab: Project boundary even at small scales should probably be an outline rather than a filled poly to prevent small projects from being obliterated by larger ones. Excellent idea to use buffer to show project boundary; however, the boundary looks like it extends quite a bit further than the extent of the outside photos. How did you determine your buffer size?
27. Metadata tab: keywords listed as Colorado, Utah, Wyoming. Would this change as you add projects in other states?
28. Photo examples tab: excellent way to present comparisons. Excellent that you picked same area, different films, etc.
29. Archive tab: coverage diagram - can't read the text
30. Make the feedback form open in a new window. It wiped out the map window and when I hit the back key I was zoomed out to the whole US. Also, put a colored box behind the yellow triangle in the legend for "View Photo" as it is difficult to see on a white background.

I would love to have all our photography in a scanned format. However, I can't imagine what the cost would be.

31. Will this site become available to members of the public once it's up and running?

32. Terrific job! I can fully appreciate your efforts. Long ago and far away I completed a course called Photogrammetry in Stratton Hall at the Colorado School of Mines during the fourth quarter of 1970. Not too far from your offices. Not many people have taken such a course.

33. Integrate into GIS

34. As more projects are added, to avoid overlap confusion the "air photo project boundary" display could be broken down by perhaps a series of years (i.e. 1966-1976).

35. The "find location" is a good feature.

36. This is a wonderful and much needed project.

37. Alaska's missing

Data Development

A major goal was to transform the photos taken off of strips into a digital format and to store them with reference information. The photos were taken on 35mm film and were all in color. The color was not a problem because the photos were taken in black and white. The color was not a problem because the photos were taken in black and white. The color was not a problem because the photos were taken in black and white.

Once the photos were in a digital format, the next step was to develop a project boundary. The project boundary was developed by using the photos to create a map of the project area. The project boundary was developed by using the photos to create a map of the project area. The project boundary was developed by using the photos to create a map of the project area.

Data Loading into SIFT

The photo center and project boundary data were loaded into the SIFT database. The photo center and project boundary data were loaded into the SIFT database. The photo center and project boundary data were loaded into the SIFT database.

Coordinate system: NAD 1983, Albers

datum: North American

spheroid: Clarke 1866

flattening: 0.0001

false easting: 0.0

false northing: 0.0

central meridian: -100.0

standard parallel 1: 33.3

standard parallel 2: 45.3

Appendix C: Data Base Design

Bureau of Land Management - National Science and Technology Center (NSTC) BLM Aerial Photography Archive Internet Mapping Service (IMS) Database Design Document

Purpose of Design

The process of searching through thousands of photo center records online can be optimized by utilizing the strengths of a relational database. The BLM Aerial Photography Archive IMS application allows for the rapid query and display of multiple geospatial data layers. This is done by connecting to an Informix database using ArcSDE, which creates advanced organization of the spatial data and decreases the display time for data layers to be rendered. The components that were taken into consideration while designing this database are described below.

Data Development:

A contractor was hired to transform the photo centers off of sheets to a digital environment and attribute them with required information. These attributes include film type, film scale, photo date, roll, etc. The contractor also scanned in a subset of photos from the actual archive, to create digital thumbnails. This data was delivered in GIS coverage format to the project lead, and then put through a QA/QC process to check the attributes of the data with the original location on the photo sheets.

Once the photo center data was approved through the QA/QC process, it was then used to develop a project boundary. This process involved using ArcGIS software to create a polygon shapefile from the three mile buffers of the photo centers. This project boundary was then smoothed (vertices removed) in order to give it a more formal shape. The project boundary shapefile was then assigned various attributes relating to the photo centers and contractor information.

Data Loading Into SDE:

The photo center and project boundary data (fully attributed) was then loaded into an SDE/Informix environment on the nirm0sde.corp.blm.gov server. This process was done using ArcCatalog software. The following tables represent the database design for these two layers. All of the data layers used in this application were loaded into ArcSDE/Informix with the following map projection, which was initially chosen because of the original projection of our shaded relief layer:

Coordinate system: NAD_1927_Albers
Datum: North American
Spheroid: Clarke 1866
Projection: Albers
False Easting: 0.0
False Northing: 0.0
Central Meridian: -96.0
Standard Parallel #1: 29.5
Standard Parallel #2: 45.5

Latitude Of Origin: 23.0
Unit: Meter

1. Photo Center Layer Design in Informix/ArcSDE

Layer: PLSS: Polygon			
field	type	index?	example
objectid	integer	yes	
Indkey	varchar(16,0)	no	NM23T0340S0150W
state	varchar(2,0)	no	NM23T0340S0150W
primer	varchar(2,0)	no	23
town	varchar(3,0)	no	034
twnfir	varchar(1,0)	no	0
twndir	varchar(1,0)	no	S
range	varchar(3,0)	no	018
rngfir	varchar(1,0)	no	0
rngdir	varchar(1,0)	no	W
blmm	varchar(80,0)	no	Las Cruces
twp_label	varchar(15,0)	yes	T34S R18W
shape	st_multipolygon	yes	Polygon
se_row_id	integer	yes	5

2. Project Boundary Layer Design in Informix/ArcSDE

Layer: Aerial Photography Project Boundaries: Polygon			
field	type	index?	example
objectid	integer	yes	
proj_name	varchar(16,0)	yes	CO-82-B1
film_type	varchar(25,0)	yes	natural color
film_locat	varchar(30,0)	yes	BLM-NSTC-Denver, CO
comments	varchar(50,0)	yes	none
proj_num	varchar(25,0)	yes	7
sheets	decimal(5,0)	yes	6
film_scale	varchar(10,0)	yes	1:24000
state	varchar(3,0)	yes	UT
index_sc	varchar(10,0)	yes	250000
film_year	varchar(5,0)	yes	1978
shape	st_multipolygon	yes	Polygon

Once the photo centers and project boundaries were successfully loaded into Informix/SDE, we could now program the application to query this database based on the field names we had chosen. We could also expedite this process by having the contractor who develops the photo center data use our field names from SDE when attributing the data.

Reference Data Layers:

We also wanted to use additional reference layers (BLM admin boundaries, hydrography, transportation networks, state boundaries, Public Land Survey, land ownership) as well as a shaded relief raster data layer in our mapping application, so that the user could search through the photo center data along with additional references. The photo center and project boundary data alone would not be very intuitive by themselves. These data layers came from internal BLM sources at the National Science and Technology Centers. Listed below is the database design for these additional reference layers.

1. Hydrography (Lines) Layer Design in Informix/ArcSDE

Layer: Rivers (Water - Line)			
field	type	index?	example
objectid	integer	yes	
fnode_	decimal(11,0)	no	59896
tnode_	decimal(11,0)	no	59896
lpoly_	decimal(11,0)	no	59896
rpoly_	decimal(11,0)	no	1
length	decimal(20,3)	no	0.575
feature	varchar(80,0)	no	Stream
name	varchar(80,0)	no	Rio Grande
state	varchar(5,0)	no	NM-TX
shape	st_multilinestring	yes	Polyline
se_row_id	integer	yes	4

2. Transportation (Roads) Layer Design in Informix/ArcSDE

Layer: Roads: Line			
field	type	index?	example
objectid	integer	yes	
fnode_	decimal(11,0)	no	26791
tnode_	decimal(11,0)	no	26793
lpoly_	decimal(11,0)	no	0
rpoly_	decimal(11,0)	no	0
length	decimal(20,3)	no	0.051
roadtrl020	decimal(11,0)	no	41909
feature	varchar(80,0)	no	Other Highway
name	varchar(120,0)	no	State Route 338
state_fips	varchar(2,0)	no	35
state	varchar(2,0)	no	NM
shape	st_multilinestring	yes	Polyline
se_row_id	integer	yes	7

3. BLM Admin Boundaries Layer Design in Informix/ArcSDE

Layer: BLM Administrative Boundaries: Polygon			
field	type	index?	example
objectid	integer	yes	
perimeter	decimal(23,5)	no	873307.5436
admin00_	decimal(11,0)	no	78
admin00_id	decimal(11,0)	no	71
stateoffic	varchar(15,0)	yes	IDAHO
district	varchar(32,0)	yes	LOWER SNAKE RIVER
resourcear	varchar(30,0)	yes	BRUNEAU
shape	st_multipolygon	yes	Polygon
se_row_id	integer	yes	45

4. Hydrography (Polygon) Layer Design in Informix/ArcSDE

Layer: Hydrography (Water - Polygon)			
field	type	index?	example
objectid	integer	yes	
perimeter	decimal(20,3)	no	0.574
hydrogm020	decimal(11,0)	no	19213
feature	varchar(80,0)	no	Lake
name yes	varchar(80,0)	no	Lake Avalon
state yes	varchar(20,0)	no	NM
shape yes	st_multipolygon	yes	polygon
se_row_id	integer	yes	16

5. Land Ownership Layer Design in Informix/SDE

Layer: Ownership: Polygon			
field	type	index?	example
objectid	integer	yes	
ownership	varchar(12,0)	yes	USFS
state_name	varchar(25,0)	yes	Washington
shape	st_multipolygon	yes	Polygon

6. Public Land Survey System (PLSS) Layer Design in Informix/SDE

Layer: PLSS: Polygon			
field	type	index?	example
objectid	integer	yes	
lndkey	varchar(16,0)	no	NM23T0340S0150W

state	varchar(2,0)	no	NM23T0340S0150W
primer	varchar(2,0)	no	23
town	varchar(3,0)	no	034
twnfirt	varchar(1,0)	no	0
twndir	varchar(1,0)	no	S
range	varchar(3,0)	no	018
rngfirt	varchar(1,0)	no	0
rngdir	varchar(1,0)	no	W
blmnm	varchar(80,0)	no	Las Cruces
twp_label	varchar(15,0)	yes	T34S R18W
shape	st_multipolygon	yes	Polygon
se_row_id	integer	yes	5

7. State Boundary (Western States) Layer Design for Informix/SDE

Layer: States (Western States): Polygon			
field	type	index?	example
objectid	integer	yes	
perimeter	decimal(21,3)	no	30.731
statesp020	decimal(11,0)	no	1385
state	varchar(20,0)	yes	Oregon
state_fips	varchar(2,0)	no	41
shape	st_multipolygon	yes	Polygon
se_row_id	integer	yes	4

8. Urban Areas Layer Design for Informix/SDE

Layer: Urban Areas: Polygon			
field	type	index?	example
objectid	integer	yes	
perimeter	decimal(17,3)	no	1.014
urbanid	decimal(5,0)	yes	5422
urbannm	varchar(50,0)	yes	Tucson
state	varchar(2,0)	no	AZ
shape	st_multipolygon	yes	Polygon
se_row_id	integer	yes	24

A shaded relief layer (raster) was also loaded into Informix/SDE and is used in this mapping application. This layer has no attributes that are used in queries or searches. This layer is primarily used to enhance the visual connotation of the site.

Appendix D: Data Development and Implementation

A contract was developed, competed, and awarded for digitizing of the photo center locations from the Mylar flightline index maps. A geodatabase was then populated with the photo center coordinates and associated attributes information. These attributes include film type, film scale, photo date, roll, etc. The contractor also scanned in a subset of photos from the aerial photography archive, to create digital thumbnails. This data was delivered in GIS coverage format to the project lead, and then put through a QA/QC process to check the attributes of the data with their original location on the photo sheets.

Once the photo center data was approved through the QA/QC process, it was then used to develop a project boundary. This process involved using ArcGIS software to create a polygon shape file based on the actual location of the photo centers. The project boundary shape file was then assigned various attributes relating to the photo centers and contractor information.

The photo center and project boundary data (fully attributed) was then loaded into an SDE/Informix environment on the nirm0sde.corp.blm.gov server. This process was done using ArcCatalog software. The following tables represent the database design for these two layers. All of the data layers used in this application were loaded into ArcSDE/Informix with the following map projection, which was initially chosen because of the original projection of our shaded relief layer:

Appendix E: Hardware/Software Configuration

The Interactive Mapping Application was initially developed with the assistance of the Oregon State Office using Moxi Media IMS front-end software and the support of one of their servers. In October 2003, the NSTC purchased and installed Moxi Media, relieving the Oregon State BLM Office from their cooperation in hosting the intranet site. This has also greatly increased the speed of the website. As of November 2003 the current hardware/software configuration for the site is:

ArcSDE: nirm0sde.corp.blm.gov (production/development internal)

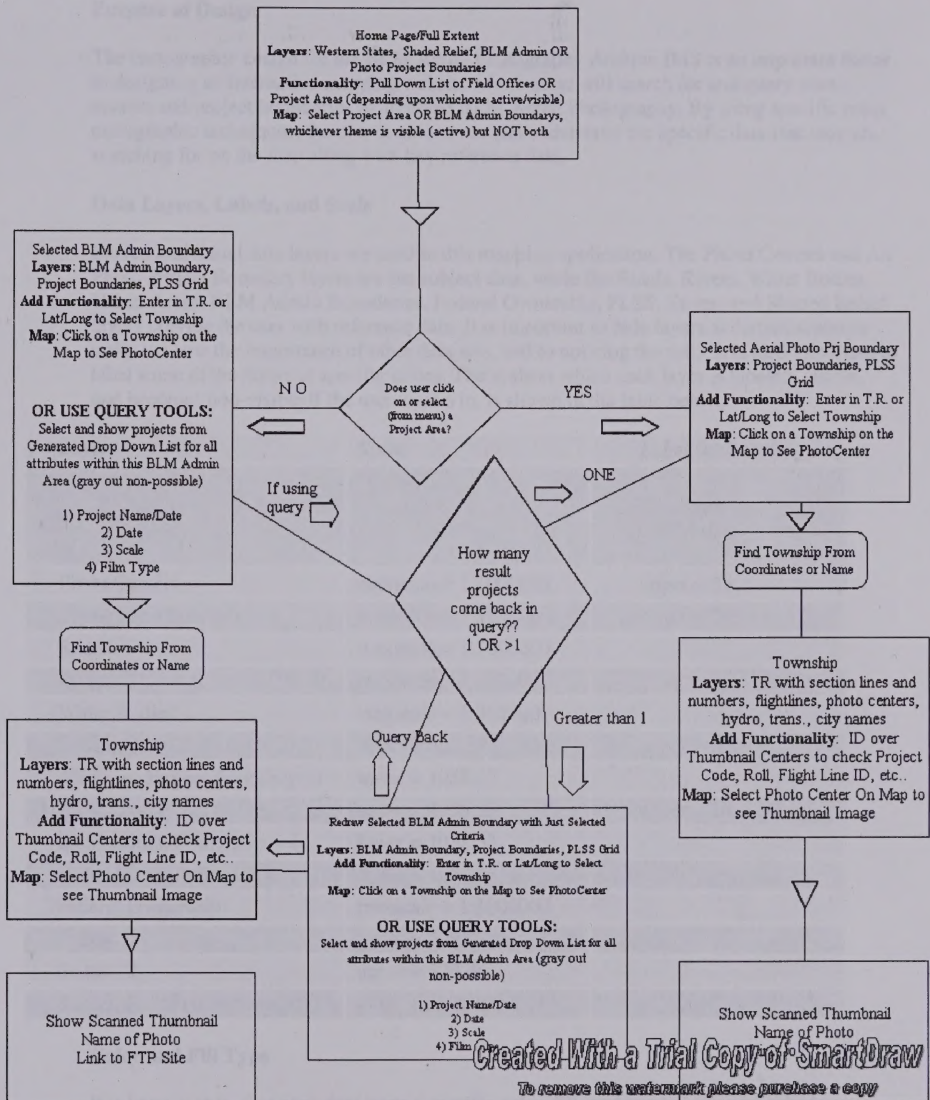
ArcIMS: ncsd3arc1.corp.blm.gov (production internal) and ncsd3arc2.corp.blm.gov (development internal)

Moxi Media: ncsd3arc1.corp.blm.gov (production internal) and ncsd3arc2.corp.blm.gov (development internal)

Web Server/Servlet Engine: The ArcIMS/Moxi Media software currently utilizes Java Server Pages, HTML, and Javascript, with the New Atlanta Servlet Exec engine on ncsd3arc1 and ncsd3arc2 servers.

Appendix F: Application Flow Chart

AERIAL PHOTO ARCHIVE
IMS DESIGN FLOW DOCUMENT
JUNE 10, 2003



Appendix G: Cartographic Design

Bureau of Land Management - National Science and Technology Center (NSTC) BLM Aerial Photography Archive Internet Mapping Service (IMS) Cartographic Design Document

Purpose of Design

The cartographic design for the BLM Aerial Photography Archive IMS is an important factor in designing an interactive mapping website where users will search for and query photo centers and project boundaries of archived BLM Aerial Photography. By using specific color cartographic techniques, the user is able to see and understand the specific data that they are searching for on the map along with key reference data.

Data Layers, Labels, and Scale

Eleven individual data layers are used in this mapping application. The Photo Centers and Air Photo Project Boundary layers are the subject data, while the Roads, Rivers, Water Bodies, Urban Areas, BLM Admin Boundaries, Federal Ownership, PLSS, States, and Shaded Relief layers provide the user with reference data. It is important to hide layers at certain scales in order to show the importance of other data sets, and to not clog the map. It is also important to label some of the layers at specific scales. The scale at which each layer is labeled, visible, and becomes non-visible if the user zooms in, is shown in the table below.

<i>Layer</i>	<i>Scale</i>	<i>Label (and scale)</i>
		= relative scale * (0.0254/dpi)
Photo Centers	maxscale = 1:1000000	upper = 35
Public Land Survey	maxscale = 1:3000000	upper = 105.83
Roads	maxscale = 1:3000000	
Rivers	maxscale = 1:3000000	
Water Bodies	maxscale = 1:3000000	
Urban Areas	upper = 352.78	upper = 352.78
Air Photo Project Boundary - 1	lower = 1058.33	
Air Photo Project Boundary - 2	upper = 1058.33	upper = 1058.32
BLM Admin Boundaries - 1	lower = 1058.33	
BLM Admin Boundaries - 2	upper = 1058.33	
Federal Ownership	maxscale = 1:1000000	
States - 1	lower = 529.05	
States - 2	upper = 529.04	
Shaded Relief (raster imagery)	minscale = 1:3000001	

Color and Fill Type

It is important to give each data layer a specific color, fill, and symbology when the layer is displayed together with other layers. The purpose of the interactive mapping component of the website is to point out specific information about a photo center or project boundary, and

provide accurate map reference information. Both of these can be done by providing the user with specific colors and symbols that they will easily recognize. Some of the layers are drawn twice with different fill patterns in order to become more or less recognizable at different scales. The scale at which each layer is drawn as well as the color (RGB) and symbology associated with each layer is shown in the table below.

Layer	Scale	Color and Symbology
Photo Centers	maxscale = 1:1000000	Square (bountiful harvest) with cross and a yellow triangle 255.255.102 on top for photo available
Public Land Survey	maxscale = 1:3000000	Boundary Only 76.115.0
Roads	maxscale = 1:3000000	Red Line 255.0.0
Rivers	maxscale = 1:3000000	Light Blue Line 0.255.255
Water Bodies	maxscale = 1:3000000	Light Blue Polygon Fill, Dark Blue Outline; fill color = 0.255.255; boundary color = 0.0.255
Urban Areas	upper = 352.78	Tan/Yellow Polygon Fill 255,255,190
Air Photo Project Boundary - 1	lower = 1058.33	Unique Polygon Fill (bountiful harvest, see list below)
Air Photo Project Boundary - 2	upper = 1058.33	Unique Polygon Outline Only (bountiful harvest, see list below)
BLM Admin Boundaries - 1	lower = 1058.33	Light Yellow Polygon Outline 255.255.153
BLM Admin Boundaries - 2	upper = 1058.33	Heavy Yellow Polygon Outline 255.255.153
Federal Ownership	maxscale = 1:1000000	Polygon Fill (multiple colors, see list below)
States - 1	lower = 529.05	Green Polygon 102.204.0 with Heavy Black Outline
States - 2	upper = 529.04	Heavy Black Outline
Shaded Relief	minscales = 1:3000001	imagery

Federal Ownership Polygon Fill RGB:

project boundary	RGB
BLM-OSBC	139,69,19
CO-76-A	240,230,140
CO-77-C	167,175,94
BLM-WWIR	139,139,0
CO-79-BC	105,139,105
CO-79-DC	255,215,0
CO-81-HI	206,195,149
CO-82-AI	192,144,88
CO-82-BI	189,183,107
MRIR	172,150,172
UT-01-AC	247,181,103
UT-78-AC	139,105,20
UT-94-BC	205,155,29
WY-80-BC	192,101,73

Air Photo Project Boundary Bountiful Harvest RGB:

ownership	RGB
BIA	253,180,108
BLM	254,230,121
BOR	255,255,179
County	143,181,190
DOD	251,180,206
DOE	143,181,190
NPS	202,189,220
Other Federal	143,181,190
State	179,227,238
USFS	179,222,105
USFWS	127,204,167
Water	230,246,249

Appendix H: Results of Historical DOQQ Questionnaire

1. Please give a general description of the project for which the DOQQ's were utilized.

- Photos covering four quads, flown in 1980 for a Natural Color resource photography project, were orthorectified by NSTC.
- NSTC engaged in a synthesis of regional information for BLM managers along the Colorado Plateau. The project tested the utility of regional information in local resource management decisions. NSTC focused on the cumulative impacts of roads and landscape fragmentation. The DOQQs were used to demonstrate landscape change and cumulative impacts at a local level. The DOQQs show landscape features not captured in broad-scale regional data.
- DOQQs used for route analysis in the travel management plan in the area.

2. What type of land management questions did the DOQQ's help you solve?

- Management needed to know acres of surface disturbance as a result of mineral activity on public lands. This information was used in the Oil & Gas permitting process.
- The data and information synthesized for the Colorado Plateau serve as a baseline of resource condition, degree of fragmentation, and land use. This information is invaluable for a range of land management issues including determining habitat condition and conducting regional assessments. The DOQQ's have helped demonstrate the degree of change in resource condition as well as the benefit of regional assessments.
- The photos help to show where recreational use is occurring and what, if any, resource impacts may be caused by changes or increases in use.

3. How were the DOQQ's utilized?

- The digital Orthophotos of this historic aerial photography provided a timeline comparison to more recent Digital Orthophoto Quarter Quads (DOQQs) and satellite imagery to map and calculate acres of surface disturbance.
- The synthesis of regional information highlighted areas of interest for finer scale resource assessment. The DOQQs were used to identify and digitize roads not captured in the regional data set. The DOQQs may also be included as a datalayer in a customized GIS tool being developed for the Colorado Plateau managers.
- Recreation: Using the photos for trend analysis to see if any changes in level of use are apparent and for additional routes created between the photo periods. The photos can be compared to see widening of routes indicating a change in type of vehicle used or an increase in use. New routes created are also evident. Changes in vegetation and riparian areas can also be monitored to see if recreation is a cause or if other factors come into play.

Hydrology: Looking over the Wolford area DOQQ, it was helpful to have the historic photos to show the increased road/trail density over the last ten years in the area, and roads that had become braided or noticeably wider with minor user reroutes. The historic also may help show how the "new" reservoir has contributed to some of the increase. I think using the old as a base map would be very helpful in discussing the need for some type of travel management in the area --- as the public could SEE the changes in the area in a relatively short time period. The photos will provide a good discussion tool!

Some vegetative changes would also be easier to map by comparing the more recent photos to the older ones-- in particular prescribed burns and wildfire patterns were more obvious when the historic photos were used for comparison. I was really interested in using the historic to look at changes in Muddy Creek since the construction of the reservoir--- aerial photography can provide an "overall" look at how the changes in water quality have affected the channel geometry. The old photos still have pretty good resolution down to the 1:3000 scale, and show tree canopy, sand bars, and the meanders. Unfortunately, the newer photos don't have as good of resolution, and at the 1:3000 scale, things get a little blurry. Comparing to the new photos still can be used to maybe pick areas for field review. I was hoping to see if the reservoir's wetland

mitigation area downstream of the reservoir could be "measured" to the historic areas-- but as I mentioned, the newer images' resolution didn't support it very well. I definitely liked the scale and resolution for larger creeks and rivers- the historic photos would be very useful for looking at these areas. I also liked being able to compare eroding areas to the historic-- most of our gullies are obviously older than 10 years, but it was interesting to see if any differences over time were observable. (once again, being able to overlay soil info. or veg info with the historic photos, identify areas of interest, and then compare them to the recent photos. would provide good way to identify/prioritize areas for field reconn..... especially if the newer photos had as good of resolution as the historic)

4. Were they compared to other types of imagery? If so what type, date, scale, resolution.

-Yes, as mentioned above in question 3, the historic photos were compared to 1994 DOQQs, which were created from 1994 NAPP photography flown at 1:40,000 scale. In addition, the historic photos were compared to panchromatic band of 1999, 2000, and 2003 Landsat 7 images. Landsat 7 multispectral bands have 30 meter resolution while the pan band has 15 meter resolution.

- Yes, TIGER 2000 and USGS-GDT National Atlas Roads DLG data (2000) at the 1:100K scale.

- We compared them with the USGS 1994 & 1999 DOQQ's.

5. How were the DOQQ's better - worse - different from the other imagery you used?

-The Digital Orthosthat NSTC created provided much finer resolution than the 1994 B&W DOQQs and the satellite imagery. In addition to offering sub-meter resolution, the orthos are natural color and enhanced photo interpretation of surface disturbance.

- Better. It is the scale and resolution that many field office specialists believe they need to accomplish specific projects. Some specialists and planners felt that the process of regional synthesis and assessment are absolutely necessary to identify areas where DOQQ imagery can be used - given the cost and effort.

- They appear to have different resolution and gray tones - difficult to say if better or not. In general, they were adequate to compare with current DOQQs and pick out significant differences.

6. Was having orthorectified imagery more useful than simple image scans? If so how?

-Orthorectified imagery then enhances data analysis capabilities using image processing and GIS software. For example, Orthorectified imagery provides a map data layer that can be superimposed on more recent imagery so that surface disturbance and change detection can be mapped and monitored.

- We haven't really tested this aspect yet, but yes in that it is necessary if we choose to include the images as a datalayer in a GIS system.

- Existing or new data collected could be overlayed on the photos. Definitely. These can be used in GIS to do better comparisons. Being rectified allows me to overlay our recent GPS route inventory and to see if the route is noticeable on the older DOQQ and what, if any, changes have occurred between photos.

7. Are there other areas, projects, resource or planning efforts for which you would like to utilize historical DOQQ?

If so please give a brief description.

-Utilization of historical DOQQs can be considered limitless in that it meets multiple needs. For example, Orthorectified imagery can be used to map historic trails and sites, monitor range health throughout the years, identify historic water use to help management decisions concerning water rights, map habitat change (including prairie dog towns), and compare flow of rivers throughout the years to answer cadastral survey questions.

- Not at this time.

- I think many resource specialists doing trend analysis would benefit. This is especially true for trends and changes in vegetation, riparian condition and size, recreational use impacts, and potentially for trespass issues where a date of disturbance may be important. With a revision of our RMP on the near horizon, the historical photos may be very beneficial.

8. Did you show or provide the historical DOQQ's to others in your office?

If so what were their reactions?

-The DOQQs were well received in the State Office and used to digitize roads that could not be identified on more recent NAPP photography and satellite imagery. In addition, the digital files are now on our internal GIS server as well as the University of Wyoming clearinghouse so that they are available for everyone to use.

- Positive - see question 5 above (although those folks weren't technically in my "office")

- The photos were reviewed by the Recreation staff and the Hydrologist. They like being able to compare the historical perspective with the new photos, to look for land changes.

9. What other type of resource specialists could utilize this type of imagery in your office?

To answer which land management questions?

-As mentioned in question 8, the imagery provides a valuable remote sensing tool for mapping natural and cultural resource data, and it is not restricted to Bureau use. Consequently, they are a tool that most resource specialists within the Bureau can use.

- The possible uses of this type of imagery seem limited only by our creativity. Certainly the imagery seems most useful in detecting changes in resource condition and use patterns at the landscape level. But then again, that's mostly the scale at which I operate and think. Vernal FO's interest was originally in oil and gas permitting and impacts on mule deer population. They have yet to pursue the use of DOQQs in that analysis - to my knowledge. But again, other planners and specialists from the Colorado Plateau indicated the imagery could be useful in planning and implementing specific projects, though not as useful at the regional planning level.

10. Any additional comments

-Once we receive scanned imagery, it's surprising how we start using it. We might have it scanned for one specific need, and then it starts meeting multiple needs...when we least expect it.

Appendix I: Prioritization of Website Questionnaire Requirements

Prioritization of Website Questionnaire Requirements	
ST - Short Term LT - Long Term OS - Beyond the Scope of This Application	
Additional Data Layers	Priority
USGS Quad Boundary	ST
PLSS down to the Parcel level	ST
PLSS Section Lines & Section Numbers	ST
PLSS Corner Locations and Boundary Lines	ST
Digital Orthophoto Quad Imagery (7.5 and 15 min)	LT
Digital Raster Graphics Imagery (7.5 and 15 min)	LT
GNIS Place names	LT
Watershed Boundaries with Labels	LT
Additional Transportation Layer (more in depth)	LT
Stream Names	LT
Actual Air Photos	LT
Landsat Imagery Index	OS
Allotment Boundaries	OS
Add MTP Data	OS
Mines, Mining related disturbances, Fluid and Solid Mineral Lease Boundaries, etc.	OS
Additional Queries	
Query by quad id or quad name -- Zoom to that area of interest	ST
Query based on Township and Range	ST
Query by GNIS names	LT
Additional Functionality	
Ability to download a shapefile or .e00 file of photo centers and attributes Complete Aerial Photography Project Boundary, BLM Field Office or State	ST
Change cursor location to read in lat/lon vs UTM	ST
Project Boundary display could be broken down by perhaps a series of years (i.e.1966-1976).	ST
Integrate with the National Map through ArcExplorer Java by using Geographic Coordinate System	LT
Having the ability to plot an image in lieu of paper prints from the film (cost savings)	LT
Download digital BLM photography from the site at 1:24000 scale	LT
Download digital BLM photography at 300 dpi	LT
Download digital BLM photography at 150 dpi	LT

Additional Functionality, continued	Priority
Identify photos required using the website, and then have them burned onto a CD and sent to the requester for loading into local GIS systems	LT
Pick photo resolution to download depending on what's available	LT
Order photography for my entire field office with one click	LT
Verify images are oriented with north to the top	LT
Make the project names come in with the same color as the project boundary and centers	LT
Make the photos easily downloadable from the site	LT
Miscellaneous Requested Changes from Questionnaire:	
Review the Univ. of Arizona's ARIA web site for design and response considerations. http://aria.arizona.edu	ST
Add Metadata tab: keywords listed as Colorado, Utah, Wyoming	ST
Cartographic	
Ownership does not match PLSS	OS
Water bodies need the outline in the map to match the legend - streams should also have the same symbol	ST
Water' (Federal Ownership) does not match 'Water Bodies' in the legend	ST
Put a colored box behind the yellow triangle in the legend for "View Photo" as it is difficult to see on a white background.	ST
Project boundary even at small scales should probably be an outline rather than a filled poly -- to prevent overlay	ST
Urban labels should be placed to the upper right instead of centered	ST
Make the project names come in with the same color as the project boundary and centers	ST
Background was too strong and competed with the air photo projects	ST
Urban and BOR colors are too similar	ST
Tilt of the projection is very distracting (most noticeable in the Northwest corner)	ST
Yellow lines are extremely difficult to see on the white background	ST
Label section numbers at high zoom levels	ST
Legend entry labels should be singular	ST
Highways need labels for location clues	ST
Labels should be visible at smaller scales	ST
Show PLSS Sections with light gray when zoomed in beyond township	ST
Fix the colors so they are sure not to contrast with adjacent projects	LT
Show the extent of a single photo with dashed line when zoomed in beyond township	LT
Label Roads and Place Names	LT
Local Government, Other Federal, and DOE look the same in the legend	LT
Verify images are oriented with north to the top	

BLM Library
Denver Federal Center
Bldg. 85, OC-521
P.O. Box 25047
Denver, CO 80225

